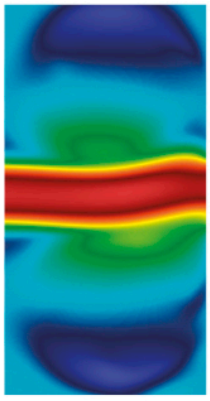
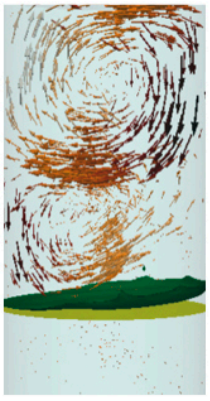
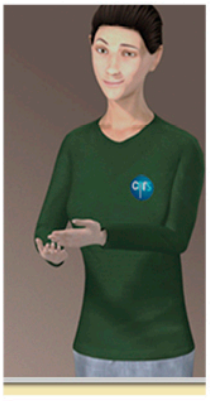
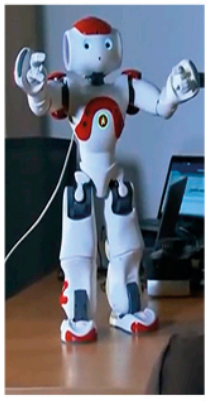
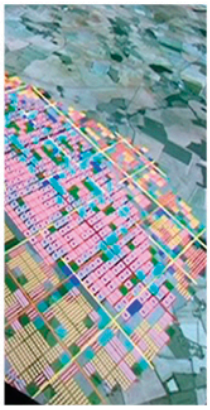
Limsi

Scientific report

2013-2014




Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur
Campus universitaire bâtiment 508 - 91405 Orsay cedex

CNRS dépasser les frontières

Université Paris Sud — Comprendre le monde, construire l'avenir®

Table of contents

General overview

FRANÇOIS YVON, ANNE VILNAT, CHRISTIAN TENAUD

LIMSI is a CNRS laboratory associated (as well as co-located) with University Paris-Sud (U-PSUD); it was also associated (until the end of 2013[1]) with University Pierre and Marie Curie (UPMC), through its historical links with UMPC's mechanical engineering component. The laboratory was created in 1972 by Pr. Lucien Malavard from Paris VI University and the French Academy of Sciences, when his former laboratory ("Centre de Calcul Analogique du CNRS") located in ONERA premises, moved to Orsay. As a specialist of theoretical and experimental fluid mechanics, Malavard strongly believed in the future of digital methods, although the computing power available at the time could not compete with analog computing systems. After a period of hybrid computing (an analog system driven by a computer) the supremacy of digital systems was fully recognized, an evolution reflected by the name of the new laboratory, "Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur", which also emphasized the focus on the Engineering Sciences. Meanwhile, activities have progressively developed to also include speech processing, computer graphics, then an increasing number of themes related to human-machine communication. A defining characteristic of the laboratory is thus its openness to a wide spectrum of research, ranging from thermodynamics to cognitive psychology, bridging across engineering and computer sciences. Multi-disciplinarity has long been (and still is) part of our DNA, and is facilitated by the rich mix of competence and expertise present in most research groups, as well as by a shared set of basic mathematical tools, a common practice of large-scale computer simulations, experiments and evaluations, and a collective expertise in scientific data visualization techniques; and, even more importantly, by a shared long-term goal, which is to improve the well-being of man in their surrounding environment, both from a material and immaterial aspect. Our research thus strives at answering a growing social demand with better means of managing and using exponentially increasing streams of information, with more efficient and natural communication interfaces between humans and machines, with more efficient industrial design processes, with means of making the best use of available energy or natural resources, and with more efficient and safer transportation systems. Part of our research is also devoted to developing more efficient artificial learning aids to improve understanding how new interaction tools modify human-human relationships and to provide substitutive capacities to aging and disabled people.

Achieving such ambitious goals requires the development of the various basic skills needed by these applications. LIMSI thus contributes to the production of knowledge in the corresponding disciplinary fields, in particular in language science and technology, in mechanical engineering and energetics, in human-machine interaction, in cognitive psychology and in ergonomics. This commits us to design, develop, analyze and evaluate new algorithms in diverse areas such as image and signal processing, statistical machine learning, multi-level and multi-physics models, advanced dynamical systems, and closed-loop control in order to improve their predicting capabilities or to make them more robust to noise, to modeling errors, or to evolving conditions. Such objectives can be achieved, for instance, by taking new physical or social effects into account, by better capturing model or parameter variability, but also by quantifying their sensitivity to various types of modeling errors, or by building resources such as annotated corpora or experimental databases.

[1] *This date corresponds to the end of the previous contractual period for UPMC ; UPMC then decided not to renew its association with two laboratories located on the campus of Paris-Sud: LIMSI and FAST.*

The quality of our research can be measured in various ways, either according to standard criteria evaluating the scientific production, or according to criteria quantifying the relevance of our research with respect to our applied objectives. Given that part of our research work aims to develop effective information processing systems for large scale applications, LIMSI has established a long tradition of comparing its results with those produced by other teams across the world. This is particularly true in the area of spoken language processing where LIMSI has been involved in US/DARPA campaigns for over 20 years, working on tasks of increasing complexity, and has regularly been ranked amongst the very best over all the years. The laboratory has also been very active in initiating similar exercises in the domain of text language processing, such as Question Answering, Information Retrieval, or Machine Translation, or more recently on Information Extraction in the medical domain. Likewise, teams working in the area of Computational Fluid Mechanics and experimental metrologies have taken part or led benchmark studies to quantify the accuracy and effectiveness of several algorithms either for the resolution of the Navier-Stokes equations or the measurements of velocity fields in specific configurations. This more common practice of taking part to open benchmarks or evaluation campaigns is another shared feature that forms part of the LIMSI culture.

As a multi-disciplinary laboratory, and owing to its openness to a wide spectrum of research activities, LIMSI is associated with four institutes of the CNRS: primarily with the Institute for Information Sciences and Technologies and their Interactions (INS2I), but also with the Institute for Engineering and Systems Sciences (INSIS), the Institute for Humanities and Social Sciences (INSHS), and the Institute of Biological Sciences (INSB). The laboratory hosts researchers evaluated by four Sections of the "Comité National de la Recherche Scientifique[2]": Section 07 (Information Sciences), Section 10 (Fluid Mechanics and Reactive Media), Section 26 (Brain, Cognition and Behavior), and Section 34 (Language Sciences).

6 Scientific organization

LIMSI is organized into two main scientific departments: the department of Mechanics Energetics (ME), and the department of Human-Machine Communication (CHM). The former is composed of three research groups and corresponds approximately to 35 to 40% of our research force; the latter is structured into six research groups including a transversal thematic action. Many cross-department activities and collaborative research actions contribute to strengthening the scientific unity of the laboratory

Mechanics Energetics (ME) Department

Fluids Mechanics and Heat and Mass Transfer are key scientific disciplines at the heart of many crucial societal challenges in the domain of energy, transportation, and environment. Achieving more efficient, more reliable, more environmentally friendly means of converting or using energy, of transporting people and goods, requires a better identification of the corresponding technological bottlenecks and in turn a deeper knowledge of the involved physical mechanisms in all their intrinsic complexity and mutual interactions. It also necessitates a continuous progress in numerical modeling and simulation capabilities that are instrumental to mastering and optimizing the technological processes that stand at the heart of a progressive substitution of empirical know-how by a deterministic approach in the conception and design processes. Along these lines, research in the Mechanical Engineering department strives towards a better understanding of fluid and transfer phenomena, isolated or in interaction, and the development of efficient methodologies, numerical or experimental, to improve the predictive capabilities of models and their numerical simulations. Achieving better predictive capabilities is also instrumental for the development of methodologies aimed at optimizing or controlling the events or processes in which these phenomena are involved. Our research thus follows a dual strategy, proceeding either along a deductive process, each

[2] *The « CoNRS » is in charge of the evaluation of CNRS laboratories and researcher.*

research topic progressing along its own logic, or along an inductive process, building upon concrete situations or configurations raised by our industrial or societal partners. We strive to keep a balance between these two approaches in order to reconcile both objectives of contributing to knowledge advancement while putting our skills at work for the benefit of society, the main specificity of engineering sciences.

Research axes

Research in the mechanics-energetics department addresses a large variety of situations in fluid mechanics and energetics. This variety stems from the range of scales which are addressed, from micro-meters in nanoscale heat transfer to tens of meters in outer aerodynamics; from the range of speeds, corresponding to incompressible flows characterized by small Reynolds numbers up to supersonic flows; from the variety of the investigation methodologies, covering both numerical and experimental techniques; from the variety of numerical methods which are used or under development, finite volume, finite element, deterministic or stochastic spectral methods as well as reduced order methods; and from the variety of objectives, from pure knowledge advancement to proof of the concept demonstrators. This diversity of methodologies and goals, which constitutes our common global scientific expertise, is organized in three research groups, Unsteady Aerodynamics (AERO), Convection and Rotation (CORO), and Solid-Fluid Transfer (TSF), which present their research individually in detail in this scientific report. These three groups share or jointly develop a large number of methodologies, both numerical and experimental. To situate our research in a more general perspective, it can be described along two main themes, “aerodynamics” and “transfer and energetics”, which provide a global coherence to our scientific project.

The laboratory has long been recognized for its skills in the methodological developments related to numerical simulation and modeling which remain essential to scientific progress in the field of Fluid Mechanics and Energetics. Besides our work on numerical methodology developments, mainly devoted to High-Performance-Computing, we have recently increased efforts on the development of uncertainty quantification (UQ) methods. Our progress in numerical methods, capitalized in massively parallel software (SFEMaNS, BLUE, SUNFLUIDH), allows us to focus on multiphysics phenomena (e.g. MagnetoHydroDynamic (MHD) coupling in Liquid Metal Batteries as energy storage medium, liquid/vapor phase change in distillation processes, or reactive flows for combustion and plasmas) to better understand the phenomena involved. Aspects related to the coupling between conduction, convection, and radiation have also been studied for high Rayleigh number configurations, either to optimize electricity production processes from solar, thermodynamic, or photovoltaic energies (collaboration LGEP) or in a more theoretical context to define scaling laws in natural convection such as applications addressing the thermal performance of buildings. Significant progress has also been made in improving understanding of basic mechanisms of transition to turbulence for better energy efficiency of aerodynamic devices and renewable energy systems. Studying heat transfers at the solid/fluid interface at very low temperatures still remains a challenge for establishing new physical laws and experimentally studying energy dissipation in micro- or nano-devices. These activities were conducted through scientific collaborations thanks to institutional instruments provided in the context of Paris-Saclay.

Because of the wide spectrum of research activities at LIMSI, work is also conducted in collaboration between research groups. The LIMSI has for many years focused on the understanding of voice production, which requires a multidisciplinary approach combining fluid mechanics, acoustics, and fluid/deformable structure interactions. This activity, supported by the International Associated Laboratory (LIA) “Physics & Fluid Mechanics”, is located at the interface between the AERO and Audio and Acoustics (AA) groups. To analyze and understand the physical mechanisms responsible for unsteady and large scale motions in fluid flows, it is instrumental to develop methods and tools capable of extracting relevant information from huge amounts of data coming from either simulations or experiments, to visualize this information and interact with the representation,

approaching real-time. This is carried out in the LidEx “Center for Data Sciences” in a collaborative work between the AERO, TLP, and VENISE groups. Bringing together our expertise in HMI and Mechanics-Energetics has also led to the development of original haptic devices based on heated/cooled air jet for additional modalities and more versatile interactions.

Computer Graphics & Thermoaeraulic Engineering support team (CIGITA)

Our research in fluid mechanics and heat transfer relies heavily on numerical simulations which are performed using our own numerical codes. Their efficient use and continuous improvement are thus at the heart of our ability to produce results at the best level. One of the objectives of the CIGITA support team is to capitalize the research efforts into numerical codes and to provide researchers with very efficient codes, implementing not only known algorithms and schemes but also new ones developed at LIMSI, making efficient use of the available computing resources. The support team has been involved over the years in the development of three numerical codes with a strong emphasis over the last 3 years on parallelization: CHORUS a massively parallel (domain decomposition) software for compressible unsteady simulations with high order schemes and possibly immersed boundaries, SUNFLUIDH a massively parallel (domain decomposition, multithreading, and GPU accelerator) software for 3D unsteady flow (DNS or LES) either in the Boussinesq regime or under the low Mach number approximation with consideration of possible reactive flows and immersed bodies, and BLUE devoted to two phase 3D incompressible flow developments, relying on the newest versions of the front tracking method with high performance on highly parallel supercomputers (Blue Gene Q in a PRACE project). In addition, the CIGITA support team also provides researchers with hardware, including both the administration and maintenance of individual computer equipment, the three clusters, and a data storage server allowing for the development of parallelization of codes and algorithms.

Experimental support team

The experimental support team provides support in the conception of set-ups for the experimental research activity carried out in the Mechanics-Energetics department, as well as for the Human-Machine Communication department, notably with Acoustics or Virtual and Augmented Reality activities. Most of its current activities are related to fluid mechanics, with a recent emphasis on the implementation of real-time feedback control loop based on plasma actuators. It also supports research in thermoacoustics, with recent developments for LDV measurements of streaming effects.

Human-Machine Communication (CHM) Department

Research in Human-Machine Communication has become increasingly important over recent decades. Two main aspects of LIMSI’s research may be highlighted: how to interact with the machine, for which more and more (hardware or software) solutions are explored, and how to process human language, which is the most natural means to exchange information. These axes constitute the two main research fields of the Human-Machine Communication Department.

Concerning interaction, our research focuses both on hardware aspects, with the development of new devices such as large tactile surfaces, haptic interfaces, and audio and/or visual reality augmenting tools for immersive interactions; and on software aspects: people interact more and more often with artificial companions would they be virtual agents, robots or connected objects. In immersive CAVE-like environment, users can also interact with life-sized virtual humans.. Studying human behavior in their interaction with artificial environments is also critical for making these interactions as natural, efficient and useful as possible. A particular field of interest, which gathers several groups, is the study and design of interaction devices and modalities in artistic contexts.

The main part of the information exchanged between humans is expressed by the means of language: either in the form of texts, for instance on a newspaper’s web site, or recordings, such as broadcast news or goal-oriented dialogues. But today’s information is becoming more and more

"user-generated", and as a result, arguably less structured; the analysis, indexation, and understanding of these various forms of "noisy" texts (forums, blogs, and micro-blogs) and audio recordings (spontaneous conversations, recorded classes and presentations, home-made videos) are less studied and pose new challenges which need to be addressed, while also providing invaluable raw material for the in-vivo analysis of actual language use. Other dimensions of language variation are also studied, alone or in combination: accentuated or emotive speech needs to be characterized, transcribed and indexed, texts and talks in foreign languages need to be translated, technical texts in specialized domains (e.g. bio-medical) need to be indexed or searched.

There are no clear-cut boundaries between all these studies. Despite the fact that the department is administratively organized in groups, many projects actually gather researchers from various groups.

Research axes

Research in the Human-Machine Communication Department addresses the different facets of communication activities. This diversity begins with the medium used to communicate: from speech to writing, sound and music, hand or full body gestures, visual contact, or a mix of these different media. The device used to interact with the machine, or with other humans via the machine, is another source of diversity: from classical WIMP interfaces (window, mouse, and keyboard), to Virtual and Augmented Reality user interfaces or intelligent sensors in an I-room.

Most of our research is concerned with multidisciplinary aspects: ergonomics (studying human activity and system use), psychology (understanding and modelling human behavior and major cognitive functions with or for the design of virtual systems), physical and perceptual aspects of acoustics (for research concerning audio), linguistics (for automatic language processing) and para-linguistics (for research on social and affective dimension of spoken and multimodal interactions), or cognitive science (for perceptual studies in robotics). The corresponding research questions require specialists from different disciplines in order to be answered.

Some research fields are strongly related to societal aspects: designing virtual signers for the deaf and Sign Language community, developing special interactions to help autistic people to communicate, to be companions for aged people, or audio interfaces to help the blind be more autonomous. All these research fields have important societal impacts.

The development of these activities requires high performance computing architectures to run demanding algorithms under strong communication constraints such as real-time operation or with the treatment of huge amounts of data.

Research is primarily organized in six groups. Human Language Technology mainly concerns the Information, Written, and Signed Language group (ILES) for research on written and signed language, and the Spoken Language Processing group (TLP) for spoken language. All the work performed in these groups is strongly related to the activities of the Institute for Multimedia and Multimodal information (IMMI), an international CNRS laboratory hosted within our premises with the aim of developing and supporting LIMSI's collaborations with two German universities (RTWH in Aachen and KIT in Karlsruhe).

The specificities of audio, speech, and music are studied within the Audio & Acoustics group (AA), at the frontier between Human Language Technology and Interaction, while also interacting strongly with the Mechanics Energetics department. The Architectures and Models for Interaction group (AMI) deals with a variety of software or devices used to interact with humans. Cognition, Perception, Use group (CPU) conducts multidisciplinary research. Researchers in computer science, psychology, and ergonomics collaborate to address research questions concerning Human-Computer Interaction from a psychological point of view, and symmetrically use virtual interfaces to better understand human main cognitive functions such as perception, emotion and learning. VENISE (for

Virtual & augmented ENvIronments for Simulation & Experiments) is the main research group in Virtual and Augmented Reality (V&AR). It develops its activities mainly on the EVE system (Evolutive Virtual Environment), an immersive, multi-sensorimotor and reconfigurable CAVE-like equipment designed, installed and actively supported by the group. VENISE is especially involved in the scientific and technological direction of the EquipEx DIGISCOPE, whose research focus is the collaborative interaction within high-performance visualization infrastructures.

The transverse action VIDA (for Virtuality, Interaction, Design & Art) is a collaborative theme dedicated to collaborations with professional artists. Researchers involved in this theme are also members of the different groups of the CHM department. These collaborations between groups are very fruitful and enable us to address the problem as a whole: taking into account both computer and human features for example.

LIMSI and the 'Plateau de Saclay'

The rural site of the 'Plateau de Saclay' was settled in the 1970's to gather together, in a small area, major academic institutions, research centers, and high-technology companies with the hope of fostering research and innovation in the area. This project, which had been dormant for almost 30 years, is back on track and LIMSI is taking part in these rapid evolutions, which should culminate in the creation of the Paris-Saclay University, ultimately resulting in major transformations of the institutional relationships between academic partners within this University.

The process was initiated in 2007 through the launch of the Digiteo research cluster (RTRA) in Computer Science with LIMSI being one of the six founding laboratories. Digiteo has played a key role in establishing the importance and position of Computer Science in the area and in putting together its main actors, involving those already present and those intending to join the Plateau in the near future. Over the years, LIMSI has benefitted from a sustained support from Digiteo, notably in the form of "chairs" for visiting scientists as well as substantial grants that have helped improve the lab's computing equipments. Several collaborative research projects have also been funded and have helped to develop internal collaborations within Digiteo, often through joint supervisions of PhD theses.

Digiteo has been instrumental in promoting the EquipEx Digiscope, which connects together interaction and visualization facilities hosted by several partners (CEA, LTCI, ECP, LRI, and LIMSI) in a collaborative environment to create a world renowned center for advanced visualization and information extraction from complex and massive data.

Digiteo also served as an incubator for the excellence laboratory (LabEx) DigiCosme, which focuses on three key challenges for Computer and Information Sciences; one of them being "DataSense" (Making sense out of massive data), which is especially relevant for the activities of the Human-Machine Communication department. Accordingly, LIMSI has taken the lead of several work packages and activities (in Knowledge Representation, Natural Language Processing, and Machine Learning) within this LabEx.

LIMSI is part of another LabEx, LASIPS, which aims at developing the collaboration within the engineering science community. LASIPS involves a multitude of laboratories and high-level teaching institutions in the Orsay area, covering a wide scientific spectrum from mechanics (both fluid and solid) to electrical and bioengineering. Over the last three years, LASIPS has funded several collaborative initiatives with nearby academic institutions (LGEP, ECP/EM2C, EP/LadHyx, etc).

Since the founding of the IdEx 'Plateau de Saclay' in early 2012, LIMSI actively participates in the ongoing discussions regarding the organization of Paris-Saclay University: the first steps have been to install the doctoral programs in Information Technologies and in Mechanical Sciences, which will start operating in early 2015. We have also been involved in the creation of two disciplinary

departments, the Information Science and Technology department and the Mechanical-Engineering department. These departments will organize the teaching and research in their respective disciplinary fields within the School of Engineering and Information Science and Technology. Interfaces between departments are essential parts of this institutional edifice and LIMSI has taken the lead of several initiatives at the frontiers of Engineering Sciences, Computer Science, and Mathematics.

LIMSI is also strongly involved in three new virtual labs (LidEx) within the IdEx Paris-Saclay: the Institute for Digital Society, a joint-venture between information and social sciences; the Center for Data Science, bringing together big-data scientists and scientific data producers; and the Institute for Control and Decision. These are places where the culture of multi-disciplinarity of LIMSI's researchers is useful in bridging the gaps between otherwise divided scientific communities.

Internal Organization

Staff

As of the 31th of December 2014, LIMSI employs:

31 CNRS researchers (of which two are emeritus): 14 Research Directors ("Directeurs de Recherche") and 17 Research Associates ("Chargés de Recherche"), of which 5 hold an HDR. These CNRS researchers are attached to their respective CoNRS evaluation sections: 17 to section 07 "Information Sciences", 8 to section 10 "Fluid Mechanics and Reactive Media", 3 to section 34 "Language Sciences", 2 to section 26 "Cognition, Behavior, Brain", 1 to section 09 "Structural and Materials Engineering, Solid Mechanics, Biomechanics and Acoustics".

50 Professors and Associate Professors (including one emeritus and one PRAG): 10 Professors and 40 Associate Professors, of which 11 hold an HDR. Faculty members are affiliated to a number of CNU sections: 24 to section 27 "Computer Science", 2 to section 61 "Applied Computer Science, Automatics and Signal Processing", 17 to section 60 "Mechanics", 3 to section 62 "Energetics", and 4 to section 16 "Psychology". 33 of them are employed by U-PSUD, 9 by UPMC, and 8 by 7 other Universities or Engineering schools.

30 Support Staff (ITAs): 28 are employed by CNRS, 1 by U-PSUD, and 1 by UPMC. 17 of these ITAs are in the Direction group and carry out general administrative, infrastructure, and computer support for the entire laboratory; the remaining 13 are more directly involved in research activities and are affiliated either to research groups or to a department, sharing their time between several groups.

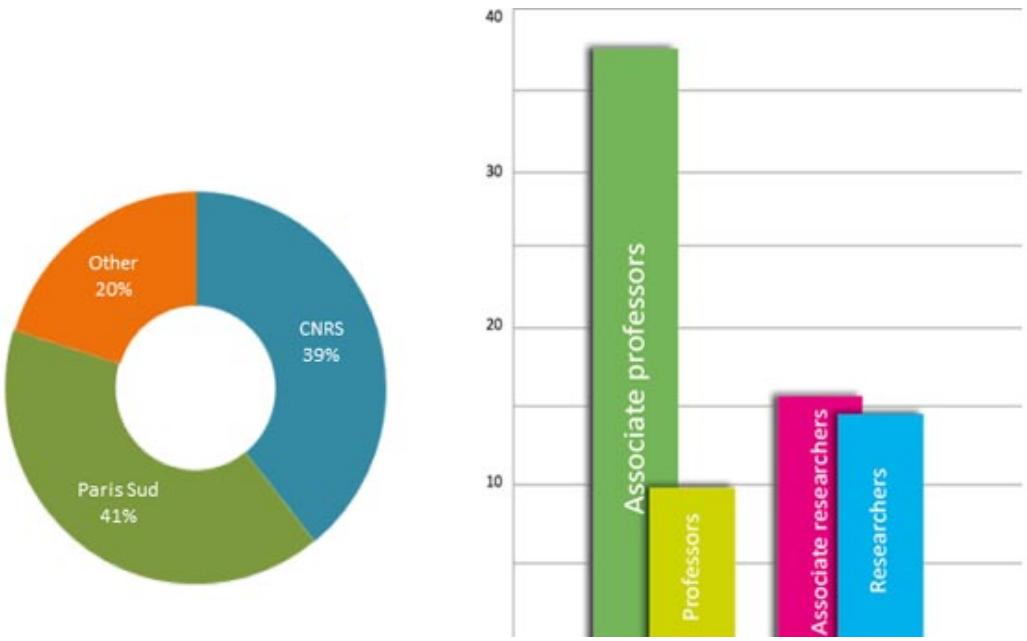


Figure 1 - Breakdown of Research Staff by Affiliation (left) & Status (right)

In summary, a grand total of 81 CNRS researchers and academics are conducting their activity at LIMSI (see Figure 1): 52 of them within the Human-Machine Communication department, and 29 within the Mechanics-Energetics department. 40 out of 81 hold an HDR. Over the years, these numbers have been relatively stable, with a shift of balance between CNRS and University staff. The balance between Associate-Professors and Professors remains extremely biased compared to the ratio of approximately one Professor for three Associate-Professors observed in most universities.

In addition to the permanent staff, about 60 to 70 students are preparing a PhD degree at LIMSI, approximately 50 in the Human-Machine Communication department and 16 in the Mechanics-Energetics department. The average number of post-doctoral interns ranges from between 20 and 30, with a fast turn-over. This has considerably increased over the last 4 to 5 years as a result of an evolution of public research funding sources which tend to be more and more allocated to short-term actions.

Support teams

Research groups benefit from the active support of various technical and administrative staff: about half of this support personnel is directly assigned to research groups (or departments); the activity of the other half is pooled to the benefit of the entire lab. These shared resources comprise the infrastructure cell, the computer support team, the documentation center, and the administration staff, which handle matters related to finance, management, contractual relationships, and human resources. A detailed organizational chart of the laboratory as of December 31st 2014 is provided at the end of this chapter.

Most, if not all, research activities at LIMSI rely on the availability of in-house high-performance computing equipment (notably 3 computer clusters, totaling respectively 96, 192, and 736 cores), large-scale data servers to accommodate petabytes of data, and several remarkable installations for studying human-machine interactions, virtual and augmented reality, ambient intelligence, audio rendering and perception, etc. With the successful deployment of the Evolutive Virtual Environment (EVE system) by the VENISE group, another significant realization was the installation of our new data center in 2014. This installation provides us with up-to-date computing facilities, improving both computer security and energy consumption, as well as making maintenance much easier. 2014 has also witnessed a major reorganization of most of the experimental installations used by the Mechanics-Energetics department, which had to be relocated in preparation for the destruction of building 502bis, and the associated experimental hall.

Recent years have witnessed a steady decrease in the number of our support staff, resulting in increased workloads for the remaining staff members. This is especially worrisome for the support of our computing facilities and research platforms which are critical for many of our research activities. A major reorganization of our support groups is underway, aiming at a better sharing of the engineering workforce within the various research groups.

Support activities are facilitated by a number of in-house, as well as external, applications and web services. The most notable applications concern staff management (to help keep track of temporary staffs and interns); and publication management, a useful tool to monitor scientific production.

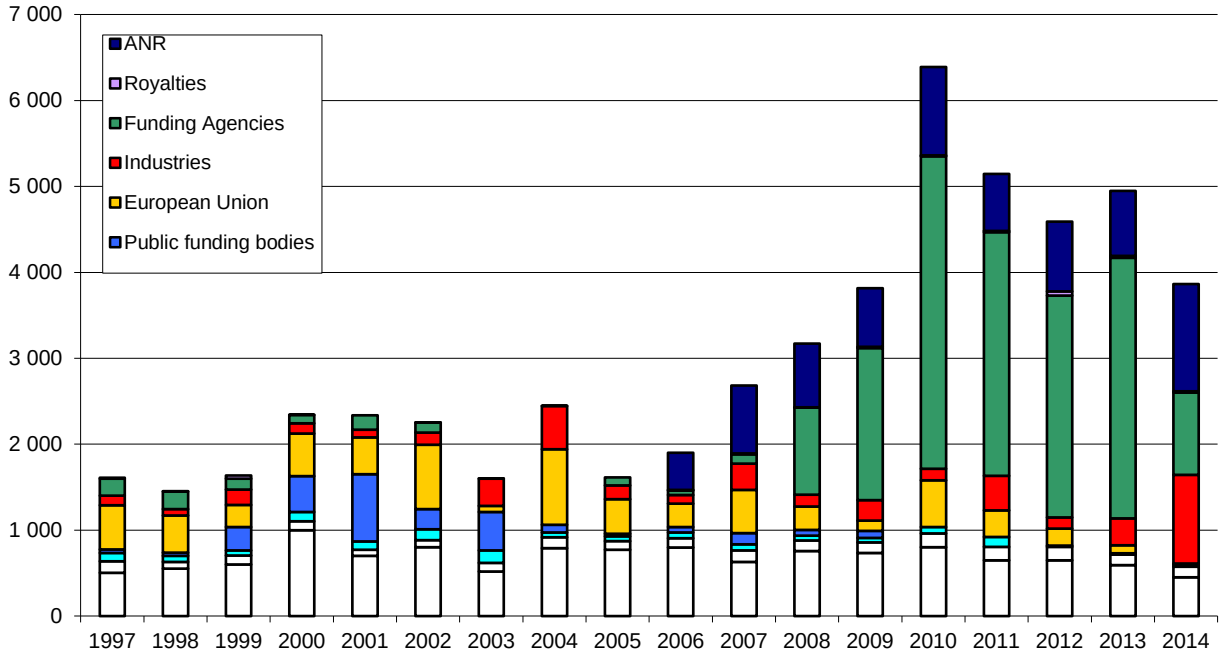
A listing of the support staff is provided at the end of this introduction; additional lists of personnel, PhDs and interns, as well as a complete listing of our publications, are included within the individual presentations of the scientific groups.

Finance

The total funding budget of LIMSI is slightly under 12 M€ in 2014, significantly below the average of the period 2009-2013(13.9 M€): owing to the end of the Quaero project, our resources are back to their 2009 level. Approximately 8 M€ is direct funding from the State (corresponding to the salaries

of the permanent staff and to State funding allocated by CNRS, U-PSUD, and UPMC) with 4 M€ corresponding to funding allocated to specific research projects by national or international financing institutions (ANR, FUI, UE, etc.). The graph below shows the evolution of LIMSI's operating resources (including both contractual resources and State support) over the last 15 years and their breakdown by funding agencies. This graph shows the considerable impact of the ANR projects as of 2006 and of the Quaero program as of 2008 on our total financial resources. It also highlights where our main effort needs be: to increase European funding contributions, returning to their mid-2000s level. LIMSI is associated with one H2020 project starting in 2015, and we anticipate additional funding with forthcoming calls.

Financial resources (State grant and contractual resources), in k€)



Contractual resources available to research groups are extremely unbalanced: internal rules have thus been adopted and implemented to share a substantial part of these resources between groups. As a general policy, approximately 15% of each contract is collected by the laboratory. These shared financial resources are used to purchase experimental and computer equipment, to provide young researchers with a small installation package, to finance missions and formations for PhD students, and to fund small-scale collaborative research projects within the laboratory. Approximately 8 to 10 projects are funded each year at an average rate of 5-8 K€, after a public hearing and a discussion within the Laboratory Council.

Governance and Internal Organization

During the first semester of 2013, LIMSI was still headed by Patrick Le Quéré, with Anne Vilnat acting as deputy director and head of the Human-Machine Department and Christian Tenaud as the head of the Mechanics-Energetics department. Starting July 1st, 2013, a new management team has been installed, headed by François Yvon (Director), with two deputy directors (A. Vilnat and C. Tenaud) heading their respective departments and an administrative officer (Karine Bassoulet) leading the support groups.

The management team has been working in close relationship with the heads of scientific groups, holding regular meetings on a monthly basis. Likewise, the laboratory council, last elected in 2008, has been meeting eight to ten times a year to discuss all subjects related to the scientific policy, to

evaluate LIMSI's internal scientific projects, and to address administrative or other internal affairs. The lifetime of the current council was extended in 2012 to sync with the new evaluation calendar of the laboratory. Elections have been held in the fall of 2014 and the new council will be installed in January 2015 for a four year term.

Several ad-hoc commissions have been meeting on a per request basis to discuss general issues related to the building premises, the laboratory web site or other web services, computing resources, or general security conditions and regulations on site. One such commission specifically addresses issues related to doctoral studies.

Highlights

This section highlights a selected numbers of activities which have been identified to cover a large spectrum of works and themes, from basic research to applications, from fluid mechanics to human-machine interactions.

Uncertainty Quantification

A Proper-Generalized-Decomposition method has been developed, based on both the Arnoldi algorithm and classical Galerkin projection methods. The efficiency of this algorithm has been demonstrated on the solution of the steady-state Navier-Stokes equations. Results show computational complexity reduction (Tamellini, Le Maître, and Nouy, 2014). Improvement of non-intrusive methods has also been reached by compressed-sensing and preconditioning approaches.

Magnetohydrodynamics and Liquid Metal Batteries

The interest of Liquid Metal Batteries (LMBs) as a possible solution for future energy storage has been clearly identified. Extension to multiphase flows of our in-house code for MHD flows (SFEMaNS) has been carried out, allowing us to simulate flows in LMBs. The first nonlinear computations of Tayler instability in LMBs were conducted and excellent agreement was found between results of a detailed theoretical study and numerical results (to appear in Journal of Fluid Mechanics, 2015).

Heat Transfer in Solid/Superfluid Helium

Pioneering measurement of the Kapitza resistance between Silicon and solid 4He (below 0.7 K) were performed. Analysis of our measurements of the Kapitza resistance between a silicon crystal and pressurized superfluid Helium revealed that thermal transfer at the interface is dominated by resonant scattering of phonons. This mechanism occurs when the phonon thermal wavelengths (2-10 nm) match surface roughness of the same order of magnitude.

Evaluation of Natural Language Processing Systems

Research activities around evaluation continue to be developed in new directions, for Natural Language Processing and other kinds of interaction. Annotation models, guidelines and annotated corpora (texts, videos,...) have been produced for Signed Language, for opinion and emotion; new metrics are designed and used in campaigns organized by LIMSI; LIMSI systems continue participate to evaluation campaigns, where they are placed at top ranks (1st in REPERE challenge).

Better Interactions with disabled people

Developing interactions for disabled people in various directions: virtual agents to help social interactions (collaboration with MIT), for autistics, robots as companions for aged people, sign language generation using a virtual signer, creation of spatial mental maps of architectural spaces for visually impaired users. This research is conducted keeping in mind ethical aspects (Report n°1 CERNA- ALLISTENE "Ethics of the research in robotics").

Virtual Singing Agents

Cantor Digitalis (digital singer) is the prototype of the research developed with success on Art and Computer Science: the software has been released under a CECILL license.

International Recognition

Lori Lamel gave a keynote speech at InterSpeech'2014 ; Pierre Zweigenbaum was elected Fellow of the American College of Medical Informatics ; Michel Denis was made Doctor Honoris Causa of Universidad de La Laguna, Spain (ULL).

Staff

Permanent staff

Last name	First name	Position	Employer	Group	Arrived	Left
Barbet	Jean-Claude	Res. Eng	CNRS	Direction		
Bassoulet	Karine	Res. Eng	CNRS	Direction		
Bélizon	Guy	Technician	CNRS	Direction	01/05/2013	
Brilhac-Roserat	Magali	Ass. Eng.	CNRS	Direction		14/05/2014
Daly	Bénédicte	Adm. staff	CNRS	Direction		
Depauw	Annie	Technician	CNRS	Direction		
Desroches	Pascal	Ass. Eng.	CNRS	Direction		
Durand	Pierre	Technician	CNRS	Direction		30/04/2013
Lassalle	Olivier	Ass. Eng.	CNRS	Direction		
Lollia	Isabelle	Adm. staff	CNRS	Direction		
Pageau-Maurice	Sophie	Adm. staff	CNRS	Direction		
Pain	Nadine	Adm. staff	CNRS	Direction		30/04/2013
Piotelat	Elisabeth	Res. Eng	CNRS	Direction		
Rajaratnam	Nicolas	Ass. Eng.	CNRS	Direction		

Bourdin	Vincent	Res. Eng	CNRS	Experimental support team		
Caqueret	Dorine	Res. Eng	CNRS	Experimental support team		
Gautier	Vincent	Technician	UPMC	Experimental support team		
Maire	Yves	Technician	U-Psud	Experimental support team		

Chergui	Jalel	Res. Eng	CNRS	CIGITA		
Fraigneau	Yann	Res. Eng	CNRS	CIGITA		

Berthelin	Jean-Baptiste	Associate Researcher	CNRS	Dept		
Hoint	Carole	Adm. Staff	CNRS	Dept		
Ronflé	Valérie	Adm. Staff	CNRS	Dept		
Rostaing	Laurence	Adm. Staff	CNRS	Dept		

Non permanent staff

Last name	First name	Group	Employer	Arrived	Left
Azhar	Abderahman	Direction	CNRS	01/06/2013	15/09/2013
Bellande	David	Direction	CNRS	01/01/2013	31/10/2013
Poirot	Romain	Direction	CNRS	01/01/2013	30/06/2013
Poirot	Romain	Direction	Université Paris – Sud	01/07/2013	31/12/2013
Poirot	Romain	Direction	Université Paris - Sud	01/01/2014	30/06/2014

Organigramme du LIMSI – 2014

Groupe Direction
K. Bassoulet

AMIC : *J.C. Barbet*, A. Depauw, O. Lassalle, E. Piotelat, N. Rajaratnam
Bibliothèque : I. Lollia
Communication – B. Daly
Infrastructure, Logistique & Audiovisuel : *P. Desroches*, G. Bélizon
Formation permanente : *I. Lollia*
Secrétaire-gestionnaire : B. Daly

Conseil de laboratoire

AP
L. Pointal
A. Choisier

Direction

Directeur : F. Yvon
Directeurs Adjoints : C. Tenaud, A. Vilnat
Administratrice : K. Bassoulet
Gestionnaire RH : S. Pageau-Maurice

Coordination Gestion
K. Bassoulet

Dépt CHM : *C. Hoint*, L. Rostaing
Dépt Méca : *V. Ronflé*
Gr. Dir : S. Pageau-Maurice, B. Daly

Département Mécanique-Energétique

C. Tenaud, Secrétaire-gestionnaire : *V. Ronflé*

Cellule CIGITA (Informatique Graphique et Ingénierie Thermoaéraulique) Y. Fraigneau, J. Chergui
Cellule Expérimentale : *V. Bourdin*, D. Caqueret, V. Gautier, Y. Maire

Groupe Aérodynamique Instationnaire : Turbulence et contrôle
B. Podvin

Outils de méthodologies numériques performants
O. Le Maître

Ecoulements instationnaires
F. Lusseyran

Manipulation et contrôle des écoulements
L. Mathelin

Groupe Convection et Rotation : Instabilités, turbulence
C. Nore

Convection
A. Sergent

Ecoulements à surface libre
C.T. Pham

Ecoulements rotatifs et cisaillés
I. Delbende, L. Martin-Witkowski

Magnéto-hydrodynamique
C. Nore

Groupe Transferts Solide-Fluide
M. Pons

Dynamique des écoulements diphasiques
M.C. Duluc, D. Juric

Dynamiques et transferts en fluide oscillant
S. Kouidri

Transferts à l'interface solide-hélium superfluide
J. Amrit

Transferts convectifs appliqués
M. Pons

Département Communication Homme-Machine

A. Vilnat, Secrétaire-gestionnaire : *C. Hoint*, L. Rostaing

Action Transversale VIDA (Virtualité, Interaction, Design & Art) : *C. Jacquemin, N. Delprat*

Groupe Information, Langues Ecrite et Signée
P. Zweigenbaum

Corpus et représentation
P. Paroubek

Multilinguisme
A. Max

Extraction et recherche d'informations précises
P. Zweigenbaum

Traitement automatique de la LSF
A. Braffort

Groupe Traitement du Langage Parlé
J.L. Gauvain

Caractérisation du locuteur
C. Barras

Dimensions affectives et sociales des interactions parlées
L. Devillers

Perception et traitement automatique de la variation dans la parole
P. Boula de Mareüil, I. Vasilescu

Analyse robuste de la langue parlée et systèmes de dialogue
S. Rosset

Traduction et apprentissage automatique
F. Yvon

Reconnaissance de la parole
L. Lamel

Ressources langagières
G. Adda

Groupe Audio & Acoustique
C. d'Alessandro

Son & espace
B.F.G. Katz

Prosodie expressive
A. Rilliard

Analyse et synthèse audio
C. d'Alessandro

Groupe Architectures et Modèles pour l'Interaction
Y. Bellik

Image & interaction
E. Frenoux

Modalités, interactions et ambiant
Y. Bellik

Interaction haptique & communication
M. Ammi

Interaction sur surfaces taciles
F. Vernier

Groupe Cognition, Perception & Usages
J.-C. Martin

Systèmes et modèles perceptifs
Ph. Tarroux

Image, langage et cognition spatiale
M. Denis

Ergonomie cognitive
C. Clavel

Agents virtuels et émotions
J.C. Martin

Groupe RV&A VENISE
P. Bourdot

Modèles de données et de simulation en RVA
N. Férey, J.-M. Vézien

Modèles d'interaction pour la RV & A
P. Bourdot

AERO
Aérodynamique instationnaire

BÉRENGÈRE PODVIN – CHRISTIAN TENAUD

Fluid flows are present in a large number of engineering fields such as transport, energy, environment, biotechnology, and health. Most of the fluid flows encountered in these fields of application are unsteady, generally turbulent, and often coupled with other physical phenomena. Mastering and controlling these unsteady flow phenomena then constitutes a major challenge regarding the design, the optimization and the operation improvement of the fluid systems. Research conducted in the "Unsteady Aerodynamics: Turbulence and Control" group aims at both improving the prediction capabilities of numerical simulations by development of high performance computational methods and developing new methods for analysis of flow dynamics in view of more effective fluid flow control. The fluid flows that are considered by the group are most often dominated by convection (high Reynolds number flows). Associating the triptych modeling / simulation / experiment, the group seeks to achieve two main objectives. The first objective, a fundamental one, focuses on the prediction, the analysis, the understanding, and the control of elementary phenomena in fluid dynamics by advancing the knowledge at large and setting bases for future technological breakthroughs. The second objective, more applied, consists in using the acquired knowledge to simulate real life flow problems to meet the technological challenges raised by human societies.

The group gathers skills in modeling, scientific computing, applied mathematics, experimentation, and fluid flow control. The scientific coherence is maintained by strong interactions between theoretical works, numerical simulations, and experiments. For instance, data retrieved from experiments and numerical simulations are compared with each other to validate modeling approaches and to characterize the dynamical behavior. The accuracy and efficiency of numerical tools designed in the group are constantly assessed through numerical tests and rigorous numerical analysis. The quality of experimental measurements is also guaranteed by a constant search for new non-intrusive experimental protocols.

The group is organized around three main themes in which specific and well-identified topics are developed:

- **High performance numerical methodologies***:* The objective of this theme is to increase the capabilities of the numerical simulations by developing reliable, efficient computational methods in order to (i) reproduce fundamental physical phenomena with a high degree of fidelity (ii) simulate realistic configurations of marked industrial interest involving complex geometries and/or multi-physics flows. The core issues associated with this theme deal with the resolution of partial differential equations describing fluid flow dynamics: they include the development of high order numerical schemes and sub-grid modeling for Large Eddy Simulation (LES), the processing of unsteady boundary conditions, and the quantification and the propagation of uncertainties.
- **Unsteady flows***:* This theme focuses on the fundamental physics of unsteady flows. It aims at a thorough description of the basic phenomena, which should lead to a better understanding, and meaningful analysis of the flow dynamics. This is achieved by combining efficient numerical simulations and innovative experimental methods with advanced dynamical analysis tools. Extraction of coherent structures, characterization of

their dynamics, and determination of the unsteady velocity-pressure coupling are carried out for highly unsteady, largely separated flows.

- **Manipulation and flow control**: This theme aims at bridging the gap between mathematical advances in control theory and realistic strategies for flow optimization, in a context of energy-saving applications (drag reduction, mixing enhancement or blockage within the fluid, energy transfer at the wall...). Fluid flow control involves several steps: reduction of the dynamics, prediction through integration of dynamical systems for real-time control, estimation and manipulation of the flow in wall regions, synthesis of control laws and development of closed loop strategies. At different stages of the process, an effort is made to include realistic constraints into the design of the control tools.

Most of our research activities are funded through research grants, in particular by the Agence Nationale de la Recherche (ANR) and RTRA foundations; for instance the group had 1 ANR projects and 1 RTRA DIGITEO grant during the period 2013— 2014. Part of our work is carried out in collaboration with groups in laboratories belonging to CNRS or the French Universities (Pprime Institute, Poitiers; EM2C/EC-Paris, Châtenay-Malabry; GEM, EC-Nantes; LMO, Université d'Orsay; Camille Jordan Institute, Université de Lyon; CERMICS/ENPC, Marne-La-Vallée; SATIE/ENS, Cachan; PMMH/ESPCI, Paris; LTPM, Grenoble; DynFluid/Arts & Métiers ParisTech, Paris; GIPSA-lab, Grenoble) or to the foreign Universities (Texas A&M University, College Station, USA; Johns Hopkins University, Baltimore, USA; MEMS, Duke University, USA; Florida State University, Tallahassee, USA; Sandia National Labs., Livermore, USA; LFD, Universidad de Buenos Aires, Argentine; Grupo de Mecânica dos Fluidos, Universidade de Coïmbra, Portugal; Polish Academy of Sciences, Warszawa). We are actively involved in the scientific activities of the Franco-Argentine International Associated Laboratory "Physics and Fluid Mechanics" (LIA PMF) through topics related to the analysis, modeling and control of fluid flows.Most of our research activities are funded through research grants, in particular by the Agence Nationale de la Recherche (ANR) and RTRA foundations; for instance the group had 4 ANR projects (one as leader) and 3 RTRA DIGITEO grant during the period 2013-2014. Part of our work is carried out in collaboration with groups in laboratories belonging to CNRS or the French Universities (Pprime Institute, Poitiers; EM2C/EC-Paris, Châtenay-Malabry; GEM, EC-Nantes; LMO, Université d'Orsay; Camille Jordan Institute, Université de Lyon; CERMICS/ENPC, Marne-La-Vallée; SATIE/ENS, Cachan; PMMH/ESPCI, Paris; LTPM, Grenoble; DynFluid/Arts & Métiers ParisTech, Paris; GIPSA-lab, Grenoble) or to the foreign Universities (Texas A&M University, College Station, USA; Johns Hopkins University, Baltimore, USA; MEMS, Duke University, USA; Florida State University, Tallahassee, USA; Sandia National Labs., Livermore, USA; LFD, Universidad de Buenos Aires, Argentine; Grupo de Mecânica dos Fluidos, Universidade de Coïmbra, Portugal; Polish Academy of Sciences, Warszawa). We are actively involved in the scientific activities of the Franco-Argentine International Associated Laboratory "Physics and Fluid Mechanics" (LIA PMF) through topics related to the analysis, modeling and control of fluid flows.

Research Activities

Topic 1: high performance numerical methodologies

*V. Daru, Y. Fraigneau, **O. Le Maître**, F. Lusseyran, L. Mathelin, L. Pastur,B. Podvin, and C. Tenaud*
PhD students and Post-Doctoral fellows: L. Monasse, A. Puscas.

Numerical methods for highly accurate fluid flow predictions *(V. Daru, Y. Fraigneau, A. Puscas, C. Tenaud, in collaboration with A. Ern and L. Monasse (CERMICS) and C. Mariotti (CEA/DAM))*

We develop a new conservative coupling algorithm for fluid–structure interaction of deformable moving bodies with a compressible flow (PhD thesis of L. Monasse and A. Puscas, in collaboration with CEA-DAM, CERMICS-ENPC). The aim was to simulate transient dynamics problems, such as the impact of shock waves onto a structure, with possible fracturing causing the ultimate breakdown of the structure. The simulation of fluid–structure interaction problems is often computationally

challenging since the coupling of the different numerical methods used for solids and fluids often results in numerical instabilities. For the coupling in space, a possible choice is to deform the fluid domain in order to follow the movement of the solid boundary: the Arbitrary Lagrangian–Eulerian (ALE) method has been developed and has widely been used for incompressible [J. Donea et al., 1982; M.A. Fernández et al., 2007] and compressible [C. Farhat et al., 2006] fluid–structure interaction. However, when solid impact or fracture occur, ALE methods are faced with changes of topology in the fluid domain that require remeshing and projection of the fluid state on the new mesh, which are costly and error and diffusion prone procedures. In order to allow for easier fracturing of the solid, we instead chose a method based on fictitious domains solving the fluid flow on a fixed Eulerian mesh, on which a Lagrangian solid body is superimposed. Using an Embedded Boundary Method, we developed a new coupling algorithm between an inviscid compressible fluid flow and a three-dimensional moving structure that potentially fractures. The coupling hinges on a Conservative Immersed Boundary method combined with a Finite Volume method for the fluid and a Discrete Element method for the structure. Special attention was given to geometrical considerations to ensure conservation and consistency of the numerical methods. The combination of the Embedded Boundary Method for the fictitious fluid domain and of the coupling strategy ensures the conservation of fluid mass and the balance of momentum and energy between fluid and solid. The method also exhibits consistency properties, such as the absence of numerical roughness on a rigid wall. The method is explicit in time in the case of a rigid structure, and semi-implicit when the structure is deformable. The time semi-implicit method avoids that tangential deformations of the structure impact the fluid, and the method converges geometrically with a non-restrictive CFL condition on the time step. To exhibit both the computationally efficiency and the robustness of the method, several simulations have been undertaken on 3D configurations considering first a rigid body [Puscas & Monasse, 2014], then a deformable structure [Puscas et al, 2014 si accepté], and finally a fragmenting one [Puscas et al., 2014. We present numerical results showing the robustness of the method in the case of a clamped beam flexed by a shock wave, and a cylinder undergoing fragmentation owing to an intern explosion.

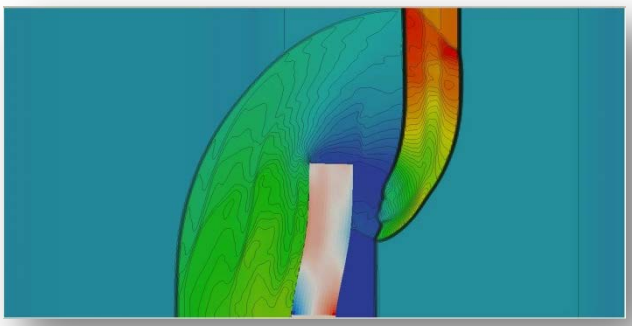
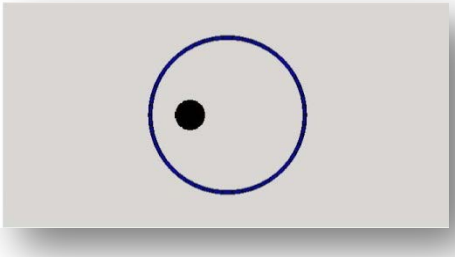


Illustration 1 - Normal stress in the beam and the time evolution of the pressure profile in the fluid at time t = 0.08s (50 contours in the fluid from 0 to 160 Pa). A. Puscas, 2014
© collaborative work between CEA-DAM, CERMICS-ENPC, and LIMSI-CNRS.



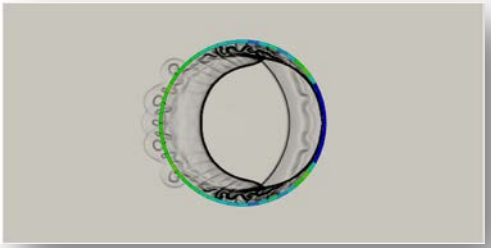


Illustration 2 - Density field in the fluid and normal stress distribution in the cylinder discretized with 50 particles at the initial time (top-left) and at times 5ms (top-right), 13ms (bottom-left), and 24.4ms (bottom-right). A. Puscas, 2014 © collaborative work between CEA-DAM, CERMICS-ENPC, and LIMSI-CNRS.

Numerical methods for low Mach liquid-gas *flows* *(V. Daru, O. Le Maître, with contributions of M.-C. Duluc (TSF group) and P. Le Quéré (CORO group)*

The simulation of two-phase (liquid and gas) flows, with phase change, must account for the compressible nature and the equation of state of the gas phase. This yields severe constraints on the simulation time-step, which should be short enough to represent fast acoustic waves. Many two-phase flows are however controlled by heat transfer rather than by pressure waves, with a characteristic fluid velocity much smaller than the sound velocity. This situation allows for the Low Mach number compressible approximation where acoustic waves are removed, and thus significantly accelerating numerical simulations. An important effort was made in these last years to develop numerical methods adapted to two-phase flows, with a dilatable gas phase characterized by a low Mach number and an incompressible liquid. This approach raises the problem of relating the pressure fields in the liquid phase and in the gas phase, because of the conceptually different nature of pressures in compressible and incompressible models. This is the case for instance when several gas bubbles with different pressures are embedded in the liquid. The differences in pressures from one bubble to another induce forces on the liquid, resulting in a flow, while the fluid inertia induces alternated expansions and contractions of the bubbles. We solved this problem by splitting the pressure into thermodynamic and dynamic components and by extending the thermodynamic pressure field in the liquid to continuously connect the thermodynamic pressures in the different bubbles (Illustration 3). The method was validated and proved to be much more efficient compared to a classical single pressure field approach (Daru et al., JCP, 2010). The method was also extended for microfluidic simulations in the TSF group.

The high resolution numerical methods that were developed to treat compressible turbulent flows with shocks are also very well adapted for the simulation of flows that are encountered in the resonators of thermoacoustic machines. In these machines, an acoustic wave is installed inside a resonator, and this generates a mean second order steady flow (the streaming flow) that is superimposed to the wave. Using a code based on the OSMP scheme, the periodic acoustic field and the streaming flow are simultaneously calculated, the streaming flow being obtained by time averaging the instantaneous flow over an acoustic period.

Numerical results show a very good accuracy of both flows, by comparison with theoretical results in the case of low amplitude acoustics, and also with experimental results at low or high amplitude acoustics [Daru et al. 2013, Reyt et al. 2013]. We are currently working on the development of a code solving the averaged equations for the streaming flow. The direct simulation code and the averaged model code will be complementary tools to analyze independently the influence of the different physical phenomena on the evolution of the streaming flow at large acoustic amplitude.

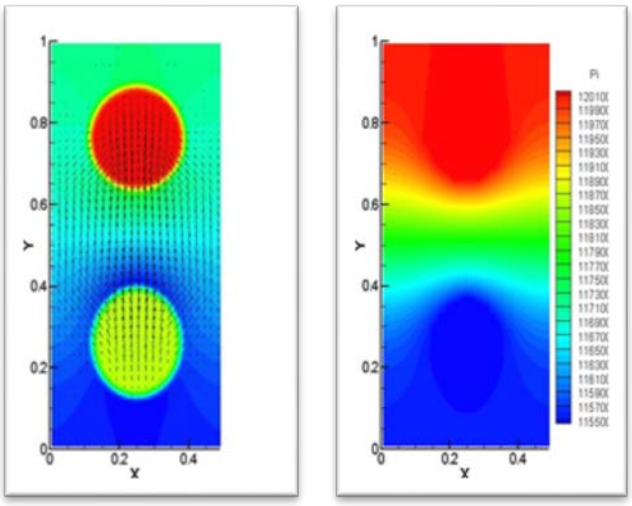


Illustration 3
Rectangular box with two air bubbles at different initial pressures inside water.
Surface tension is taken into account.
Velocity field superimposed on the dynamic pressure field at time 1µs (left),
extended thermodynamic pressure field (right)

High Performance Computing *(Y. Fraigneau, O. Le Maître, F. Lusseyran, L. Pastur, C. Tenaud in collaboration with M. Baboulin and Y. Wan and J. Fabre (LRI)*

The emergence of plateforms with hybrid GPU / CPU architectures has called for an adaptation of the computer codes to take full advantage of these new computational resources. In collaboration with M. Baboulin at LRI (Orsay), the parallelization on hybrid architectures of the code Sunfluidh, which solves the weakly compressible Navier-Stokes equations on structured grids, as been performed. The parallelization relies on a classical domain decomposition approach, with distribution over multiple CPU nodes, and multi-threaded local resolution with GPU-based acceleration. The parallelization of the code main components has shown significant performance gains, the GPU acceleration being particularly promising. The project is supported by Digiteo through the funding of a PhD-thesis (Y. Wan, to be defended in February 2015, Paris-Sud, co-advisors M. Baboulin (LRI) and O. Le Maître).

Detection and tracking of Lagrangian coherent structures require high computing performances. Following the Finite Time Lyapunov Exponents (FTLE) technique, divergence and contraction rates of the flow trajectories are determined in the frame of Florimond Guéniat PhD. However, the detection and tracking of these structures is a computationally demanding task, requiring the treatment of massive amounts of data. An optimized software, based on hybrid computer configuration (GPU / CPU), has been developed for FTLE calculation of 2D and 3D velocity fields. The optimization was done in two steps: (i) a vectorization step following the SIMD model which led to a reduction in the computing time of more than 3 decades (illustration 4-a), (ii) deporting map computations on a GPU chipset increase the efficiency by one decade (illustration 4-b). All the estimations are done using a laptop and the performances are largely increased when using dedicated hardware.

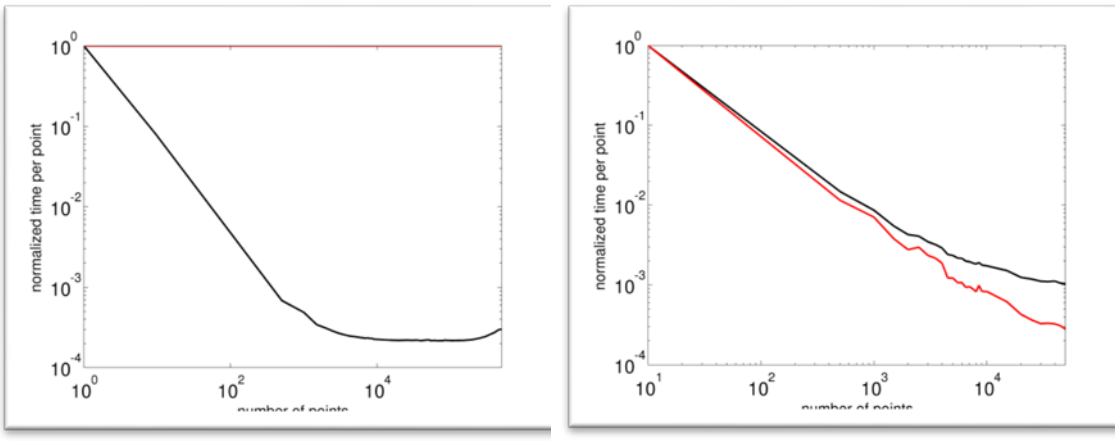


Illustration 4:
(a) influence of an SIMD algorithm on intermediary-fow computations.
(b) influence of a GPGPU treatment of interpolation.

Uncertainty Quantification Methods *(O. Le Maître, L. Mathelin)*

Uncertainty quantification methods, in particular stochastic spectral methods, have been developed at LIMSI these last years. Within the ANR project TYCHE, the researches have focused on the design of novel spectral representations and dedicated algorithms to deal with high-dimensional problems involving many random variables in the uncertainty parameterization. In particular, low-rank and reduced bases approaches have been considered in the context of complex non-linear models such as the incompressible Navier-Stokes equations and the shallow water equations.

In the context of the Galerkin projection approach, a Proper-Generalized-Decomposition method have been developed; it used an Arnoldi algorithm to construct sequentially a reduced deterministic basis for the stochastic velocity field while a classical Galerkin projection is used to determine the stochastic coordinates of the flow in the reduced basis. This algorithm has been successfully tested on the steady Navier-Stokes equations to demonstrate its efficiency and the resulting computational complexity reduction [Tamellini, Le Maître and Nouy, 2014]. Current works concerns the extension of the PGD approach and algorithms to other model types (wave equations), to improve the robustness of the PGD method with respect to nonlinearities, and its generalization to other low-rank format (canonical, hierarchical, Tensor-Train,…).

For the non-intrusive approaches, where samples of the model output are available for different realizations of the random parameters, a new stable Least-Squares type approach have been proposed for the reconstruction of polynomial surrogates in high-dimensions from a limited number of samples [Mathelin, 2014]. The method uses a model selection procedure to achieve a computational complexity scaling linearly with the size of the search space and roughly quadratically with the number of samples.

Finally, we have continued our previous works on time-transformations for the case of dynamical systems with random parameters having almost surely stable asymptotic periodic dynamics. The case of the von Karman laminar flow around a cylinder for stochastic inflow conditions has been considered in [Schick, Heuveline and Le Maître, 2014]. We have shown that stochastic orbits could be determined by solving an appropriate non-linear problem expressing the periodic character of the flow and an iterative algorithm has been proposed for the resolution of this non-linear problem. We have shown that the direct computation of the periodic orbits requires in this example a low spectral polynomial order, when a classical time-integration approach would result in prohibitively costly computations.

Topic 2: unsteady flows

V. Daru, N. Delprat, Y. Fraigneau, F. Lusseyran, L. Pastur, B. Podvin,D. Sciamarella and C. Tenaud ; PhD students and Post-Doctoral fellows: J. Basley, C. Douay, F. Guéniat, F. Tuerke

Relevant characterization and analysis of unsteadiness is still a challenging task in fluid mechanics. The group develops internal joint know-how in numerical simulation, experiments and signal processing in order to capture the main characteristics of the time-space behavior of more or less organized flows.

Coupling analysis from spanwise and axial dynamics in an open cavity flow. *N. Delprat, Y. Fraigneau, F. Lusseyran, L. Pastur, J. Basley, C. Douay, F. Guéniat; in collaboration through the LIA PMF and the STICAM-Sud program, with A. Cammilleri (LFD, UBA), J. Carlier (FLUMINENCE, INRIA), E. Memin (FLUMINENCE, INRIA) and, G. Artana (LFD, UBA)).*

The interaction of a boundary layer with an open cavity is encountered in many real configurations, for instance in transport engineering (pantograph cavity on a TGV, opened side window or roof on a car, etc) or in environmental applications (street canyon within the canope) as well as in biotechnology and health (glottal flow configuration). In this generic flow configuration, the coupling between the mixing layer and the flow inside the cavity produces large unsteadiness, usually responsible for noise production as well as containment of the inner flow, which for instance is an important issue for pollutant contamination in some applications. The work undertaken for several years is conducted in the frame of different projects (ANR DIB & CORMORED, DIGITEO Fluctus & Muse, PhD Thesis F. Guéniat) and supported by DGA & CNRS grants of two PhD Theses (J. Balsey and C. Douay).

In the last year, we focused our attention on three specific axes mainly dedicated to the detailed analysis of the flow structures, tool developments for coherent flow structure identification, and development of modal decompositions for a better understanding of the space-time non-linear dynamics:

- Regarding values of the control parameters (Reynolds number, aspect ratio, cavity depth), a spanwise alley of pairs of counter-rotating vortices, forming vortical torus-like structures around the main inner recirculation flow, may develop due to centrifugal instabilities (Illustration 6 -a). In this configuration, we determined the stability properties of the two-dimensional steady base state with respect to spanwise perturbations and found three branches of growing modes. Experimentally, we studied the bifurcations encountered in the inner flow, varying both the Reynolds number and the cavity aspect ratio. We have shown that different families of solutions, stationary or propagative, could be selected depending on the aspect ratio of the cavity, as recently predicted by a linear stability analysis of this flow (Meseguer et al JFM 752 (2014) , 219) .
- Modal decompositions have also been employed to analyze and deduce the dynamics of the flow. Coherent structures in the permanent regime could be extracted from velocity fields obtained by PIV and time-resolved PIV and direct numerical simulations, using proper orthogonal decomposition (POD), global Fourier modes or dynamic mode decomposition (DMD). We directed a thorough analysis of the couplings between the shear-layer oscillations and the inner-flow. This includes drastic interactions with 3D structures issued from centrifugal instabilities, covering a range of frequencies two decades wide (Illustration 6 -c).
- We worked on the detection and tracking of Eulerian and Lagrangian coherent structures, in the frame of DIGITEO Fluctus and ANR DIB projects, in collaboration with LRI (Orsay), Pprime (Poitiers) and PSA. Following the Finite Time Lyapunov Exponents (FTLE) technique, divergence and contraction rates of the flow trajectories were determined. Ridges of the scalar field made of local divergence rates can be defined as (quasi)

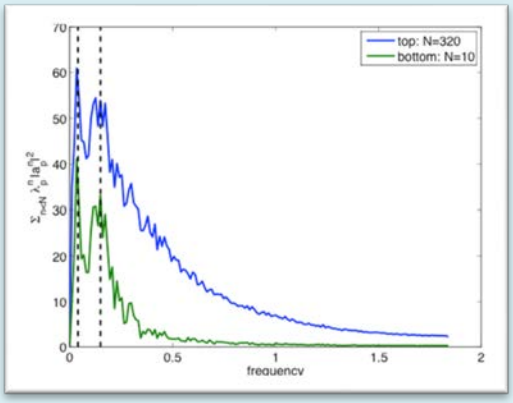
Lagrangian structures (LCS) that are surfaces embedded in the fluid through which the flow rate is minimum (Illustration 6 -b).

- In collaboration with G. Artana, in the framework of the LIA PMF, we developed an algorithm that combines Proper Orthogonal Decomposition with spectral methods (namely Dynamic Mode Decomposition) to analyze and extract reduced order models from time data series of velocity fields. Flows under consideration are assumed to be driven by non-linear dynamics exhibiting complex behaviors. Model reduction relies on both energetic and spectral criteria, something required when dynamical features that are energetically not significant may be lost. For instance, energy sinks are usually associated with fine structures whose energetic contribution is negligible compared to dominant structures. As a consequence, reduced order models may blow up on finite time scales due to energy accumulation. Since spectral modes are associated with eigenvalues lying on the unit circle, such models are guaranteed not to blow up over time scales several times larger than the observation time range. This approach has been applied with success to time-resolved PIV fields from a cylinder wake flow at a Reynolds number of 3900.

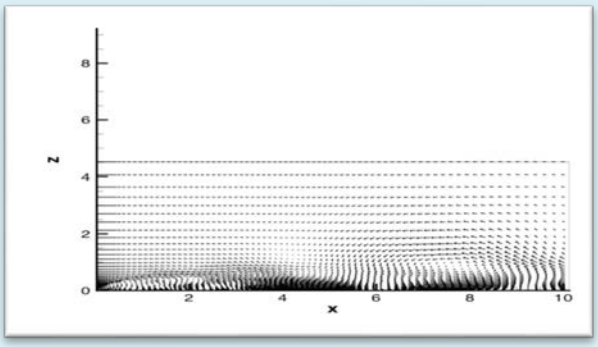
Boundary layer of a thick flat plate *(Y. Fraigneau, B. Podvin and C. Tenaud)*

We have been investigating the flow around a thick flat plate, which provides a simplified setting to study and control flow separation on vehicles. Extensive POD analysis was carried out for the full 3-D velocity field as well as for the surface pressure on one side of the plate. POD analysis shows that outside the recirculation bubble, the most energetic motions consist of large-scale vortices shed downstream of the reattachment point (Illustration 5 a)). The spanwise extent of these vortices is of the order of the plate thickness H and their separation is about 1 to 2H. These motions are characterized by two frequencies fH/U0 = 0.04 and fH/U0 = 0.12, as can be seen in Illustration 5 b). The first frequency is associated with the flapping of the recirculation bubble and scales with the recirculation length, while the second frequency is associated with the shedding process and scales with the height of the bubble. A satisfactory agreement was reached with the results of Kiya and Sazaki (JFM 1985) and Trun's PhD thesis (2012). POD analysis of the surface pressure shows that the same frequencies can be identified on the surface (Illustration 6 a). In addition, it was found that that the pressure modes are quasi-invariant in the spanwise direction (Illustration 6 b). The vortical motions that can be deduced from the pressure modes are most intense in the reattachment region.

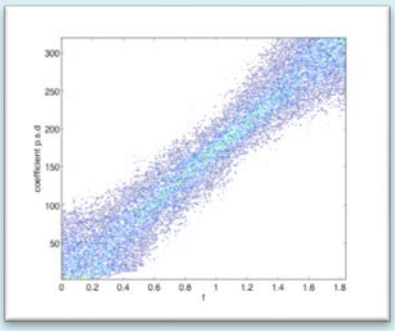
We have also begun to investigate the effect of forcing at the upstream end of the plate. The forcing is uniform in the spanwise direction and consists of a time-periodic blowing and aspiration. Preliminary computations appear to indicate that the effect of forcing is to make vortex shedding more intense (Illustration 7). More detailed computations are planned in the near future.



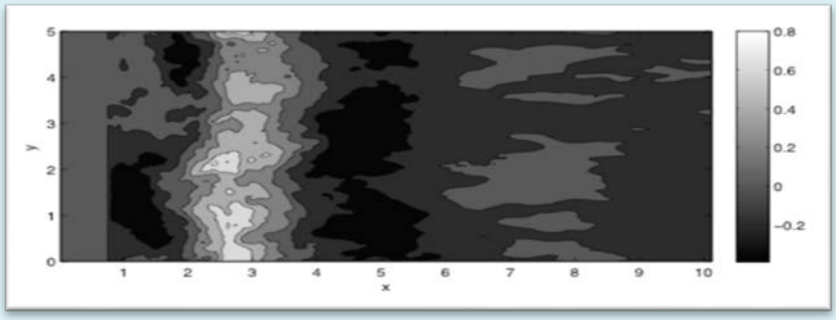
5a) Spectral content of the first N POD fluctuating velocity modes for various truncations



5b) Most energetic fluctuating POD velocity mode



6 a) Distribution of the POD coefficients associated with the pressure



6 b) Most energetic POD surface pressure mode

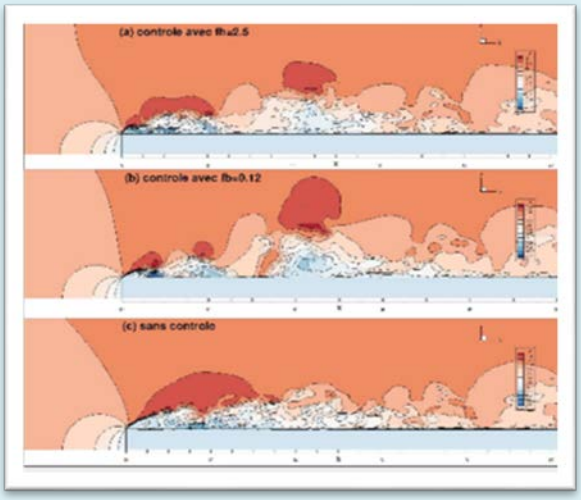


Illustration 7
Streamwise component of the velocity in a longitudinal plane

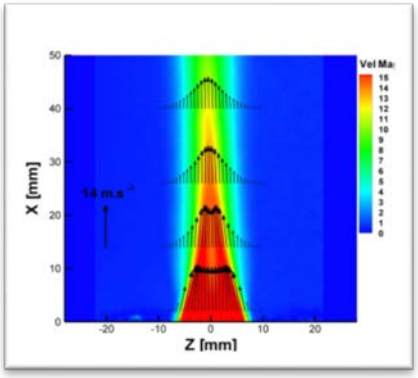
7a) forced flow with f=2.5 (twice the Kelvin-Helmholtz frequency)
7b) forced flow with f=0.12 (vortex shedding frequency)
7c) no forcing

Pulsating jets and voice production (*D. Sciamarella, I. Delbende, and F. Lusseyran in collaboration with G. Artana, Univ. of Buenos-Aires through the LIA PMF with a Post-Doc (P. Audier)*

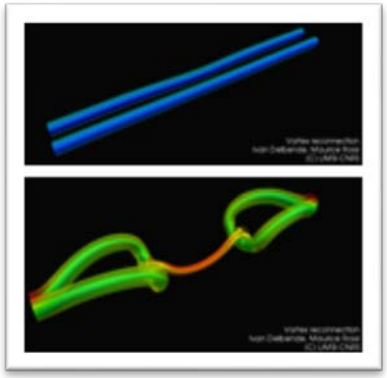
The glottal jet is the biological flow generated at the larynx during phonation. The glottis is the slot defined by the vibrating vocal folds, whose oscillation is flow-induced and self-sustained. The assessment of the dynamics and topology of the process governing this kind of jet is an active research subject that we address from three perspectives: flow physics, low-order modeling and biomimetics. Research is developed in collaboration with the LFD, a partner laboratory of LIMSI in the Franco-Argentinian International Associated Laboratory in the Physics and Mechanics of Fluids (LIA PMF). In this research period we have conducted experiments (with Pierre Audier) and numerical simulations (using Gerris, with Ivan Delbende) to confirm and understand the flow physics of the splitting-fusion-switch sequence observed for the jet issued by a life-size static vocal-fold model. Splitting occurs in a very narrow flow zone and has never been reported in the field - an article reporting the analysis of this novel result is under submission. An abstract with numerical results is submitted to PANACM 2015. Postglottal flow in low-order dynamical systems modeling vocal fold motion is customarily considered one-dimensional, in contradiction with what is observed. A vocal-fold model is conceived integrating a relaxation distance before the flow effectively complies with the quasi-parallel approximation. An article with this model is in press in Speech Communication (DOI:10.1016/j.specom.2014.11.002). A second article deals with the acoustical

effects of a space-time dependent distribution of intraglottal pressure and air particle velocity is submitted to this review. In the field of biomimetics, a high-frequency rotatory valve was designed and constructed to mimic the production of the typical glottal flow waveforms: a patent proposal for this invention is pending. Finally, experiments with plasma actuation (with Pierre Audier) are being planned to freeze, by a suitable excitation, the topological structure of the jet flow at exit of the glottal-like model.

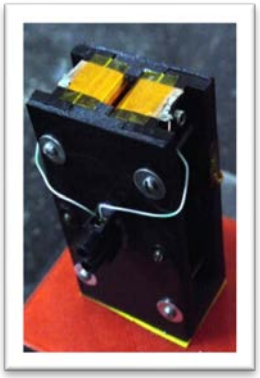
Illustration 8



(a)
Splitting-merging-switching sequence of the jet core in the mid-sagittal plane from PIV measurements



(b)
Two frames of the formation of vortex rings from two vortex lines through the Crow instability from a numerical simulation



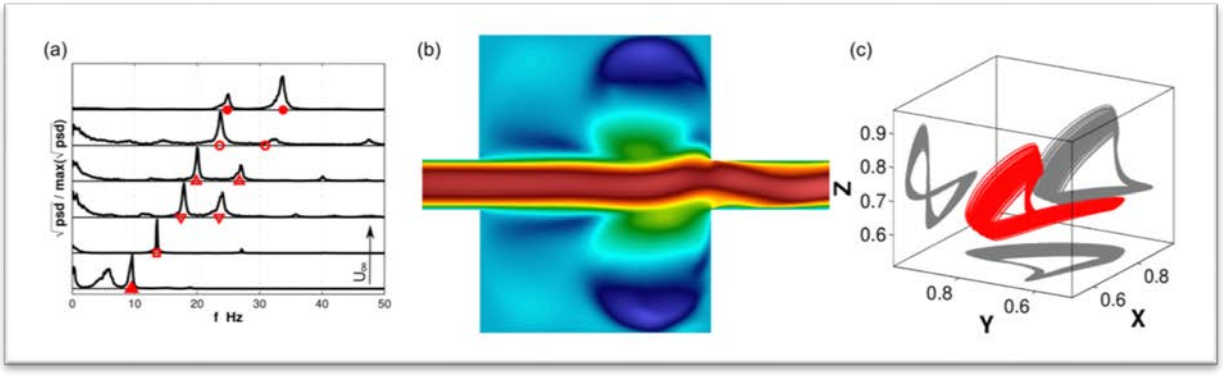
(c)
Glottal flow model with plasma actuation

Single/Double Open Cavity Flow Comparison *(D. Sciamarella, F. Lusseyran, L. Pastur & Y Fraigneau, in collaboration with G. Artana, Univ. of Buenos-Aires through the LIA PMF with F. Tuerke's thesis in co-tutorship).*

An extension of the classical fluid mechanical problem of a single-cavity flow is here considered. In that case, Florian Tuerke (PhD Student in a LIA-PMF co-tutorship) is working on the characterization of the dynamics of the flow induced by two facing cavities. The first part of his work deals with a new approach of the linear instability analysis of an open single-cavity flow. A new perspective on non-harmonic mode coexistence, commonly found in the shear layer spectrum of open cavity flows was obtained using the coincidence condition first proposed by Kulikowskii. This analysis leads to the theoretical prediction of the discrete non-harmonic frequencies which compare well with experimental results. A paper is under review in Phys. Rev. E.

In parallel, 2D and 3D numerical simulations are performed (using the in-house DNS code SUNFLUIDH – Y Fraigneau). Wind tunnel experiments are carried out mainly in UBA and secondarily in LIMSI. Time series analysis for nonlinear dynamical systems is applied to the data extracted from the 2D DNS results to investigate the onset of chaos. The double cavity is characterized in terms of two control parameters: the distance between the two cavities and the Reynolds number based on the momentum thickness. The behavior of the 2D numerical double cavity becomes more complex as the Reynolds number is increased. The time series analysis applied to the 3D numerical simulation yields different results, suggesting that the dynamical role of the third spatial dimension is not negligible. It is likely that the coupling problem between the two cavities can be probably better addressed in terms of the interaction between the four subsystems: two shear layers and two recirculation regions.

Illustration 9



(a) Theoretical Analysis: Y offset graph comparing the results from linear stability analysis in a finite domain (red symbols) with the square root of the normalized power spectral density (psd) of experimental results. (black graphs), measured using a LDV technique.

(b) Numerical Analysis: Streamwise velocity component from a 2D numerical simulation of the Double Cavity. Flow from left to right.

(c) Chaos Analysis: Phase portrait (time delay embedding) of time series during transition to chaos recorded at a shear layer position of the Double Cavity.

Topic 3: flow manipulation and control

Y. Fraigneau, F. Lusseyran, L. Mathelin, L. Pastur, B. Podvin, S. Pellerin.
PhD students and Post-Doctoral fellows: C. Douay (PhD); O. Semeraro (Post-Doc)

Here is a quick overview of our activities in flow control. They cover both modeling, numerical simulations and experiments.

Manipulation of unsteady flow over vehicles *(S. Pellerin)*

Reactive control constitutes another option to achieve drag reduction in aerodynamic applications such as the automobile industry. The idea is to use upstream wall actuation to modify vortex dynamics in the recirculation region. It requires a thorough understanding of the physics of unsteady separation and its induced drag, as well as of the action of wall generators. To this end we have developed a numerical simulation tool based on the (v-ω) velocity-vorticity formulation for incompressible flows, which allows (i) accurate simulation of a given configuration (ii) direct manipulation of the flow through modification of the vorticity at the boundary. Only results for the reference flow have been performed.The two chosen cases are 3D unsteady and turbulent flows, using LES. A penalization method is used to take into account the solid bodies. The grid comprises 6 million points.The first configuration corresponds to flow over a flat plate with a ramp with angles 25°-42° and constitutes a benchmark case for the GDR "Contrôle des décollements". Simulations are performed for Re=8.4×104 (U∞ = 25.2m/s). The second configuration is the famous Ahmed body which is today studied focusing on two aspects: the influence of the ground distance on wake structures and a wake asymmetry observed experimentally. Simulations are performed for Re=1.7×104 (U∞ =10m/s). The pressure coefficient Cp agrees with experimental data, in terms of values and evolution

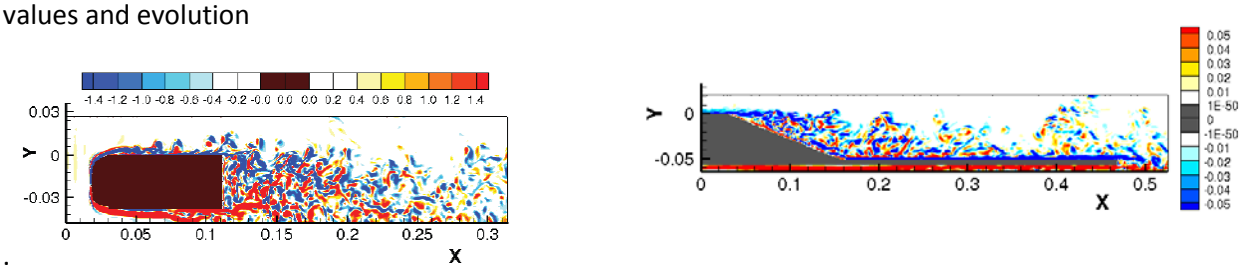


Illustration 10: Snapshot of the spanwise velocity wz,
(a) flow over a ramp, (b) flow over the Ahmed body with a blunt rear part.

Synthetic wall boundary conditions for the simulation of wall turbulence *(B. Podvin, Y. Fraigneau)*

Simulation of wall turbulent flows requires a high resolution near the wall in order to capture the intricate small-scale mechanisms involved in the generation of turbulence. This results in considerably cumbersome computations and hampers the ability of DNS to explore very high Reynolds numbers. We have been carrying out simulations of a channel flow where the wall region is excluded and replaced with a time-varying Dirichlet condition which acts as a boundary condition on the reduced simulation domain. The condition is reconstructed from POD eigenfunctions or modes which are supposed to be known a priori. The time-varying amplitudes of the POD modes are estimated from the simulation in the reduced domain. Tests have been carried out for a series of increasing Reynolds numbers (Podvin and Fraigneau, JoT 2014) and have shown that it is most important to recover the phase information correctly. As Illustration shows, the method results in statistics which agree well with those of a full simulation.

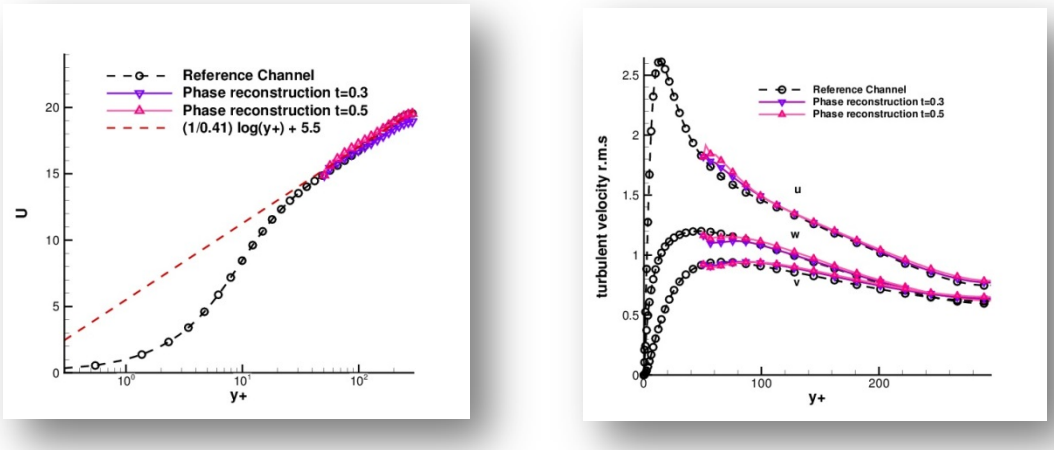


Illustration 11: Left: Mean velocity profile; Right: Turbulent intensities

Sytem observer from scarce wall-mounted sensors *(L. Mathelin)*

An effort toward efficient system observers has started with the thesis of Kevin Kasper. The goal is to derive an observer of physical systems from a limited amount of information. This is a realistic situation and the derived methodology is applicable to actual configurations where sophisticated visualization techniques are not available (e.g., an aircraft in flight). The approach consists in deriving an approximation basis specifically for the system at hand with the constraint of being observable from the available sensors. This dictionary learning method, with sparsity constraints, is illustrated on the two-dimensional flow around a cylinder. A very good performance, as compared with the standard approach relying on a POD approximation, is obtained.

Experimental closed-loop control of an open cavity flow *(L. Pastur, F. Lusseyran, C. Douay)*

In another effort, we intend to apply forcing and closed-loop control techniques to the self-sustained oscillations of an open cavity flow, at zero Mach number. Plasma DBD actuators (Illustration 15) have been implemented on the experimental setup, at the cavity leading edge. As expected, beyond a critical forcing amplitude and forcing frequencies not too far from the natural dominant frequency of the shear layer, the shear layer oscillations lock on the forcing frequency (Illustration 16). More noticeably, the forcing of the shear-layer oscillations significantly affects the inner-flow organization, modifying the dynamical properties of spanwise instabilities. A reduced-order model for the cavity flow is developed in a joint work with the SATIE Lab (Cachan), in the framework of the COPERSFI DIGITEO project which supports the PhD Thesis of M. Rizi. The closed-loop control is applied in 2D

direct numerical simulations of the cavity flow (OLORIN code), with DBD actuators modeled as volumic forces and pressure sensors at the cavity trailing corner. We proposed a time-delayed command for the suppression of the self-sustained oscillations of a flow past an open cavity. The asymptotic cost of the control vanishes as a natural (unstable) state of the system is eventually stabilized. In addition, the suppression of the limit cycle (self-sustained oscillations) makes possible the identification of a linear model for the dynamics of the flow close to the unstable fixed point (steady state). The linear model actually captures fine details on the steady state instability and proved to be robust against reasonable variations of the Reynolds number (of about 15%) and thickness of the boundary layer (about 3.5%).

On the experimental side, two closed loop control models were implemented, both based on time-delayed actions. One is aimed to stabilize unstable periodic orbits (Pyragas scheme), the second one to stabilize the unstable steady state (see here above). Though the later proved to be efficient in numerical simulations of the flow, both commands failed in the experiment; further investigations are however required, in particular in consideration of the DBD actuator features and real-time filter designs. Finally, input-output-based models should soon be implemented.

Staff

Permanent staff

Last name	First name	Position	Employer	HDR	Arrived	Left
Daru	Virginie	MCHC	ENSAM			
Guermond	Jean-Luc	DR2	CNRS	HDR		
Le Maitre	Olivier	DR2	CNRS	HDR		
Lusseyran	François	DR2	CNRS	HDR		
Mathelin	Lionel	CR1	CNRS			
Pastur	Luc	MC	Université Paris-Sud			
Pellerin	Stéphanie	MC	Université Paris-Sud			
Podvin	Bérengère	CR1	CNRS	HDR		
Sciamarella	Denisse	CR1	CNRS			
Tenaud	Christian	DR2	CNRS	HDR		

PhD Students

Last name	First name	Arrived	Thesis defense	Ecole Doctorale	School / University
Acharya Neelavara	Shreyas	01/10/2013		MIPEGE	Université Paris-Sud
Douay	Christelle	01/10/2010	04/06/2014	SMAER	UPMC
Kasper	Kévin	01/11/2013		EDSP	ENS CACHAN
Ossama	Ahmed	01/10/2013		SMAER	UPMC
Pinto	Joao	01/10/2008		SMAER	UPMC
Puscas	Maria Adela	13/10/2011	09/10/2014	MSTIC	Université Paris Est
Rizi	Mohamed-Yazid	01/09/2011		EDSP	ENS CACHAN
Tuerke	Florian	10/12/2012		MIPEGE	Université Paris-Sud
Guéniat	Florimond	01/10/2010	06/12/2013	MIPEGE	Université Paris-Sud
Acharya Neelavara	Shreyas	01/10/2013		MIPEGE	Université Paris-Sud
Douay	Christelle	01/10/2010	04/06/2014	SMAER	UPMC

Non permanent staff

Last name	First name	Position	Employer	Arrived	Left
Artana	Guillermo	Professeur invité	Université Paris-Sud	18/05/2014	27/06/2014
Douay	Christelle	CDD Doctorant	CNRS	01/10/2013	30/11/2013
Lucor	Didier	Chercheur CNRS	CNRS	08/09/2014	05/03/2015
Rouillon	Thomas	IR	CNRS	15/02/2013	28/02/2013
Rouillon	Thomas	IR	CNRS	01/03/2013	31/03/2013
Rouillon	Thomas	IR	CNRS	01/04/2013	15/06/2013
Rouillon	Thomas	IR	CNRS	16/06/2013	28/07/2013
Semeraro	Onofrio	CDD Post-Doc	CNRS	01/09/2014	31/08/2015
Gueniat	Florimond	CDD IE	Université Paris-Sud	01/10/2013	31/10/2013
Gueniat	Florimond	CDD IE	CNRS	01/11/2013	30/11/2013
Artana	Guillermo	Professeur invité	Université Paris-Sud	18/05/2014	27/06/2014
Douay	Christelle	CDD Doctorant	CNRS	01/10/2013	30/11/2013
Lucor	Didier	Chercheur CNRS	CNRS	08/09/2014	05/03/2015

Internships

Last name	First name	Arrived	Left	Prepared degree	School / University
Dao	Co	06/01/2014	09/02/2014	L3	Université Paris-Sud
Daussin	William	07/01/2013	08/02/2013	L3	Université Paris-Sud
Daussin	William	07/04/2004	04/07/2014	M1 Physique Appliquée	Université Paris-Sud
Duhem	Erik	31/03/2014	31/08/2014	M1	Université Paris-Sud
Guillonnet	Adrien	06/01/2014	09/02/2014	L3	Université Paris-Sud
Li	Xiuquan	21/01/2013	22/03/2013	L3	Université Paris-Sud
Narci	Arnaud	16/01/2014	27/02/2014	M2 DFE	Université Paris-Sud
Ngouamba	Elie Merveille	06/01/2014	07/02/2014	L3	Université Paris-Sud
Ossama	Ahmed	08/04/2013	08/08/2013	M2 DFE	Université Paris-Sud
Ouzzine	Kahina	18/03/2013	09/08/2013	Master 2	UPMC
Pivot	Charles	18/03/2013	31/07/2013	M2	Université Paris-Sud
Randrianifahanana	Sandrine	29/04/2013	26/07/2013	Master Énergie & Environnement	UPMC
Razanamparany	Sitraka	16/01/2014	27/02/2014	M2 DFE	Université Paris-Sud
Shao	Yinlong	01/04/2014	30/09/2014	M2	Université Paris-Sud
Wu	Haotian	31/03/2014	31/07/2014	M2	NULL
Yinlong	Shao	06/01/2014	09/02/2014	M2	Université Paris-Sud

Indicators of scientific notoriety

Prizes and awards

- [F. Guéniat], Meilleur poster DIGITEO, septembre 2012

Scientific events

- [F. Lusseyran], co-organisateur avec J.C. Batsale de la session 18: Mesures expérimentales et Mesures de champs, CFM 2013, Bordeaux, 26-30 August 2013
- [L. Pastur], comité d'organisation de l'école non-linéaire de Peyresq, 2013

- [D. Sciamarella], pivot of the organization and speaker, Biblioteca Nacional de la Ciudad de Buenos Aires, 14 april 2013
- [D. Sciamarella], principal organizer and speaker, Stic-AmSud Meeting on Physics-Based Voice Production Modeling, Buenos Aires, 19-20 November 2013

Editorial activities

- [Le Maître O.], Editorial Board member, International Journal for Uncertainty Quantification, since 2012

Invited lectures, talks or seminars

- [Le Maître O.], Plenary Speaker, SIAM Uncertainty Conference, Savanna-GA, 2014
- [Le Maître O.], Invited Lecturer, Ercoftac Industry Event, Paris, 2013
- [Le Maître O.], Keynote Speaker, 38th Woudschoten Conference, Netherland, 2013
- [Le Maître O.], Invited Lecturer, van Karman Institute, Brussel, 2014
- [Le Maître O.], Invited Speaker, Workshop “Numerical Methods for High-dimensional problems”, Marne la Vallée, 2014
- [Le Maître O.], Invited Lecturer, Workshop BOQUSE, Bordeaux, 2013
- [Le Maître O.], Invited Speaker, Workshop “Numerical Methods in UQ”, HCM, Bonn, 2013
- [F. Lusseyran], 'Coherent structures identification inside self-organized and pulsating 3D flow', Experiments in Fluid Mechanics - EFM 2013, 14-15 OCTOBER 2013, Institute of Aeronautics and Applied Mechanics, Warsaw, Poland.
- [L. Mathelin] A preconditioning technique for parameterized PDEs, Séminaire de Mathématiques Appliquées et de Calcul Scientifique, CERMICS, ENPC.November 2013,
- [L. Mathelin], Quelques stratégies méthodologiques pour le contrôle de systèmes complexes, Groupe de Travail SHY, Labex DIGICOSME, ENSTA, March 2014
- [L. Mathelin], An Occam's razor paradigm for the control of complex systems and beyond..., séminaire Golosino de l'ENS Ulm et ESPCI, May 2014.
- [L. Mathelin], Une stratégie parcimonieuse pour le contrôle de systèmes complexes, Institut de Mathématiques de Bordeaux, September 2014
- [L. Mathelin], Techniques for dealing with high-dimensional uncertain quantities, Lecture series on Uncertainty Quantification at von Karman Institute., September 2014
- [L. Mathelin], Une stratégie de réduction de modèle pour le contrôle d'écoulements expérimentaux en boucle fermée, Séminaire ARISTOTE, Ecole Polytechnique, October 2014.
- [L. Mathelin], An Occam's razor paradigm for the control of complex systems, séminaire Scientific Computing, TU Kaiserslautern (Germany), October 30 2014.
- [L. Mathelin], Novembre 2014, An Occam's razor paradigm for the control of complex systems, Groupement de Recherche "Contrôle des Décollements", Orsay.
- [L. Pastur], Eulerian and Lagrangian coherent structures identification in fluid flows, Invited Lecture at the van Karman Institute Lecture Series on « Advanced post-processing of experimental and numerical data » November 2013
- [L. Pastur], Time-delayed feedback control for experimental flows Invited seminary at PPRIME, July 2013
- [L. Pastur], Lagrangian and Eulerian criterions for coherent structure identifcation Invited Lecture to the AFVL meeting on «Post-processing of expérimental and numerical data», November 2012
- [B. Podvin], Modèles réduits pour la turbulence développée, Séminaire Aristote, École Polytechnique, October 2014
- [D. Sciamarella], Biomimetic Flows: Innovation inspired on fluid-structure interaction systems in nature, CAFCI Informative Meeting. Buenos Aires, Buenos Aires, November 5-7, 2013.

- [D. Sciamarella], La Física del Aire entre las Cuerdas Vocales… o el lado de la voz que no miramos, Invited talk at Hospital de Clínicas José de San Martín, May 5, 2013.
- [D. Sciamarella], Fluid dynamical issues in vocal fold toy models, Séminaire Gipsa-lab, Grenoble, October 10, 2014
- [D. Sciamarella], II Stic-AmSud Meeting Physics-Based Voice Production Modeling, Valparaíso, August 5-7, 2014
- [D. Sciamarella], Phénomènes 3D dans les écoulements glottiques, Journée de Dynamique des Fluides sur le Plateau de Saclay, Orsay, 11 February, 2014
- [F. Tuerke], Road to Chaos in the Double Cavity, XIII Meeting on Recent Advances in Physics of Fluids and its Applications, Tandil, November 5-7, 2014

Participation in expertise and administration of research

- [Le Maître O.], proposal evaluator, ANR, 2013-2014
- [F. Lusseyran], expertized project CPER 2013, Grands Réseaux de Recherche de Haute-Normandie, Réseau 'Energie', 'Amélioration du Transfert Thermique par Application d'un CHamp Electrique (THETE_ATTACHE)', 04/02/2013
- [B. Podvin], evaluator, ANR, 2014
- [C. Tenaud], expert of the Research National Agency (ANR), 2013
- [C. Tenaud], member of the CT2a GENCI Commitee for High performance Computing facilities.
- [C. Tenaud], expert of the CRIHAN, computing facilities of Haute-Normandie county.
- [C. Tenaud], president of the jury for a CNRS Research Engineer position.

Ph.D and Habilitation committees

- [Le Maître O.], PhDs (5, acting as reviewer), Habilitations (2 as reviewer, 1 as committee member)
- [F. Lusseyran], PhD : (supervisor), 2 (referee), 1 committee member
- [L. Mathelin], 2 PhD (1 examinateur + 1 président)
- [L. Pastur], 1 PhD (examinateur)
- [B. Podvin], 2 PhD(1 referee + 1 supervisor)
- [C. Tenaud], PhD's : 3 acting as reviewer and 2 acting as president; habilitation : 1 as commitee member.

Position in Scientific Concils or Associations or Networks

- [Le Maître O.], external member of the Scientific Board, GdR Mascot-Num research group, since 2012
- [D. Sciamarella], Project head, 13-STIC-08: Physics-based modeling of voice production, SticAmSud Program involving France, Argentina, Brasil and Chili, 2013-2014.
- [D. Sciamarella], Project head, Red Virtual en Física y Mecánica de Fluidos, Programa Raíces, Resolución 545/13, July 2^{d}, 2013.
- [D. Sciamarella], Responsible for the area on Biomechanic Flows of Axis 2 in the Laboratoire International Associé en Physique et Mécanique des Fluides (LIA PMF), 2013-2017
- [C. Tenaud], member of the Scientific Commitee of the LabEx LaSIPS
- [C. Tenaud], member of the Scientific Commitee of the GdR "Control of Detached Flows"
- [C. Tenaud], member of the French Council of Mechanics (CNMF)

Dissemination and scientific outreach

The group participates in Fête de la Science (oct. 2014).

- [F. Lusseyran], organisation (oct. 2013) of the mechanical department of LIMSI to the 'Fête de la science'.
- [D. Sciamarella & P. Audier], Journées franco-argentines : 50 ans de coopération scientifique pour l'innovation, 5-6 novembre 2014. Vidéo en répresentation du LIA PMF : www.youtube.com/watch?v=qAxh4W3KnxQ. Institut Français, Ambassade de France en Argentina, Ministerio de Relaciones Exteriores y Culto de la República Argentina, Presidencia de la Nación (Mincyt).

Research conventions and contracts

Starting date	Ending date	Acronym	Catégorie	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/01/13	31/12/15	Cool Jazz	Collaboration de recherche	ANR	Lesshafft Lutz	Lusseyran François	National	73 417	Non thématique
29/11/12	29/02/16	JDF	Autre	Lasips	Tenaud Christian	Tenaud Christian	National	1 000	Soutien Colloque
15/12/11	14/12/14	Bourse	Autre	EADS	Duguet Yohann	Duguet Yohann	Industriel	132 000	Financement de thèse
01/01/10	N. C.	LIA Franco Argentin	Collaboration de recherche	CNRS	Romat Hubert	Sciamarella Denisse	International	7 550	
01/01/14	31/12/14	STIC-AmSud	Collaboration de recherche	CNRS	Sciamarella Denisse	Sciamarella Denisse	International	2 000	STICAmSud
01/09/14	31/08/17		Collaboration de recherche	ENS Cachan	Tenaud Christian	Tenaud Christian	National	-	
01/10/11	30/09/14	CALIFHA	Collaboration de recherche	Digiteo	Baboulin Marc	Le Maitre Olivier	National	-	
01/09/11	31/10/14	COPERSFI	Collaboration de recherche	Digiteo	Mathelin Lionel	Mathelin Lionel	National	-	

Scientific publications

Doctoral theses and HdR

1. Gueniat, F., *Détection de Structures Cohérentes dans des Écoulements Fluides et Interfaces Homme-Machine pour l'Exploration et la Visualisation Interactive de Données Scientifiques* 2013, thèse de l'Université Paris-Sud. Soutenue à Orsay, le 06/12/2013, 199 p.
2. Puscas, M.A., *Méthode de couplage conservatif entre un fluide compressible non-visqueux et une structure tridimensionnelle déformable pouvant se fracturer* 2014, thèse de l'Université Paris-Est. Soutenue à CERMICS, ENPC, le 09/10/2014, 141 p.
3. Brunet, L., *Etude expérimentale paramétrique des propriétés et transitions de l'écoulement intra-cavitaire en cavité ouverte et contrôle de l'écoulement*, 2014, thèse de l'UPMC. Soutenue à Orsay le 04/06/2014. 230p.

Articles in peer reviewed scientific journals

1. Alexanderian, A., F. Rizzi, R. Muruhan, O. Le Maitre, and O.M. Knio, *Preconditioned bayesian regression for stochastic chemical kinetics.* Journal of Scientific Computing (Springer), 2014. **58** (3): pp.592-626.
2. Basley, J., L. Pastur, N. Delprat, and F. Lusseyran, *Space-time aspects of a three-dimensional multi-modulated open cavity flow.* Physics of Fluids, 2013. **25** (6): pp.064105_1-064105_26.
3. Basley, J., L. Pastur, F. Lusseyran, J. Soria, and N. Delprat, *On the modulating effect of three-dimensional instabilities in open cavity flows.* Journal of Fluid Mechanics, 2014. **759**: pp.546-578.

4. Cammilleri, A., F. Gueniat, J. Carlier, L. Pastur, E. Memin, F. Lusseyran, and G. Artana, *POD-spectral decomposition for fluid flow analysis and model reduction.* Theoretical and Computational Fluid Dynamics, 2013. **27** (6): pp.787-815.
5. Daru, V., D. Baltean, C. Weisman, P. Debesse, and G. Gandikota, Two-dimensional numerical simulations of nonlinear acoustic streaming in standing waves. Wave Motion, 2013. 50 (5): pp.955-963.
6. Douay, C., T. Faure, and F. Lusseyran, *Stereoscopic PIV using optical flow: application to a cavity recirculation.* Experiments in Fluids, 2013. (54): pp.15.
7. Duarte, M., S. Descombes, C. Tenaud, S. Candel, and M. Massot, Time-space adaptive numerical methods for the simulation of combustion fronts. Combustion and Flame, 2013. 160 (6): pp.1083-1101.
8. Faure, T., *Velocity field and parametric analysis of a subsonic, medium-Reynolds number cavity flow.* Experiments in Fluids, 2014. **55** (11): pp.18.
9. Feuillebois, F., S. Tabakova, S. Radev, and V. Daru, Entrained film of ice-water slurry with impinging supercooled water droplets. Journal of Engineering Physics and Thermophysics, 2014. 87 (1): pp.51-68.
10. Gao, Z., A. Sergent, B. Podvin, S. Xin, P. Le Quéré, and L.S. Tuckerman, *Transition to chaos of natural convection between two infinite differentially heated vertical plates.* Physical Review E, 2013. **88** (2): pp.023010_1-023010_18.
11. Gueniat, F., L. Pastur, and F. Lusseyran, *Investigating mode competition and three-dimensional features from two-dimensional velocity fields in an open cavity flow by modal decompositions.* Physics of Fluids, 2014. **26**: pp.085101.
12. Guermond, J.-L., J. Léorat, F. Luddens, and C. Nore, *Remarks on the stability of the Navier–Stokes equations supplemented with stress boundary conditions.* European Journal of Mechanics - B/Fluids, 2013. **39**: pp.1-10.
13. Jackson, A., A. Sheyko, P. Marti, A. Tilgner, D. Cébron, S. Vantieghem, R. Simitev, F. Busse, X. Zhan, G. Schubert, S. Takehiro, Y. Sasaki, Y.y. Hayashi, A. Ribeiro, C. Nore, and J.-L. Guermond, *A spherical shell numerical dynamo benchmark with pseudo-vacuum magnetic boundary conditions.* Geophysical Journal International, 2014. **196** (2): pp.712-723.
14. Le Maitre, O., L. Tamellini, and A. Nouy, *Model reduction based on proper generalized decomposition for the stochastic steady incompressible Navier-Stokes equations.* SIAM J. Sci. Comput., 2014. **36** (3): pp.1089-1117.
15. Lusseyran, F., P. Debesse, D. Baltean, and M.X. François, *Oscillating and streaming flow identification in a thermoacoustic resonator, from undersampled PIV measurements.* Meas. Sci. Technol., 2014. (25): pp.16.
16. Marti, P., N. Schaeffer, R. Hollerbach, D. Cébron, C. Nore, F. Luddens, J.-L. Guermond, J. Aubert, S. Takehiro, Y. Sasaki, Y.y. Hayashi, R. Simitev, F. Busse, S. Vantieghem, and A. Jackson, Full sphere hydrodynamic and dynamo benchmarks. Geophysical Journal International, 2014. 197 (1): pp.119-134.
17. Mathelin, L., *Quantification of uncertainty from high-dimensional scattered data.* Int. J. Uncertainty Quantification, 2014. **4** (3): pp.243-271.
18. Mathelin, L., E. Atam, and L. Cordier, *A hybrid approach for control of a class of input-affine nonlinear systems.* Int. J. Innov. Comput. Infor. Control, 2014. **10** (3): pp.1207-1228.
19. Podvin, B. and Y. Fraigneau, *POD-based wall boundary conditions for the numerical simulation of turbulent channel flows.* Journal of Turbulence, 2014. **15** (3): pp.145-171.
20. Podvin, B., Y. Fraigneau, C. Tenaud, and V. Daru, *Coherent structures in the boundary layer of a flat thick plate.* Comptes rendus de Mécanique, 2014. **329** (12): pp.8p.
21. Podvin, B. and P. Le Quéré, *Nonlinear dynamics between two differentially heated vertical plates in the presence of stratification.* Theoretical and Computational Fluid Dynamics, 2013. **27** (1-2): pp.89-114.
22. Reyt, I., V. Daru, H. Bailliet, S. Moreau, J.-C. Valière, D. Baltean, and C. Weisman, *Fast acoustic streaming in standing waves: Generation of an additional outer streaming cell.* Journal of the Acoustical Society of America, 2013. **134** (3): pp.1791-1801.
23. Roca, P., T. Duriez, A. Cammilleri, L. Mathelin, and G. Artana, *Streakline-based closed-loop control of a bluff body flow.* Physics of Fluids, 2014. **26**: pp.047102.
24. Schick, M., V. Heuveline, and O. Le Maitre, *A Newton–Galerkin method for fluid flow exhibiting uncertain periodic dynamics.* SIAM/ASA J. Uncertainty quantification, 2014. **2**: pp.153-173.

25. Sochala, P. and O. Le Maitre, Polyomial Chaos expansion for subsurface flows with uncertain parameters, Advances in Water Resources. Advances in Water Resources, 2013. 62 (A): pp.139-154.

Book & chapters in books

1. Mathelin, L., *Some strategies for uncertainty quantification in high-dimensional spaces*, in *Von Karman Lecture Series -- Uncertainty Quantification in Computational Fluid Dynamics - STO-AVT-235*, N/A, Editor. 2014, Gianluca Iaccarino, Catherine Gorlé and Thierry Magin. pp. 33.
2. Pastur, L., *Mesurer la pression*, in *Techniques de mesures en mécanique des fluides*, Pastur Luc, Editor. 2013, Hermes Lavoisier. pp. 69-88.
3. Pastur, L., *Eulerian and Lagrangian coherent structures identification in fluid flows*, in *Advanced post-processing of experimental data*, collectif, Editor. 2013, von Karman Institute. pp. 1-21.

Conferences with proceedings and review committee

1. Gao, Z., B. Podvin, A. Sergent, and S. Xin. *Chaotic dynamics of a convection roll in a highly confined, vertical, differentially heated fluid layer*. in *Rencontre du Non-Linéaire*. 2014. Paris, France. 39-44.
2. Gao, Z., B. Podvin, A. Sergent, S. Xin, and P. Le Quéré. *Period-doubling scenario and crisis-induced intermittency in natural convection between two vertical differentially heated plates*. in *Congrès Français de Mécanique*. 2013. Bordeaux, France. 6p.
3. Gueniat, F., M. Delorme, L. Pastur, and f. lusseyrand. *Décomposition en modes dynamiques économique pour l'identification de structures cohérentes dans des écoulements 3D*. in *Rencontre du Non-Linéaire*. 2013. Paris. 6p.
4. Hétru, L., O. Montagnier, and T. Faure. *Dynamique tourbillonnaire de l'interaction entre deux profils en tandem à forte incidence : caractérisation PIV*. in *Congrès Français de Techniques Laser*. 2014. Marseille, France.
5. Issartel, P., F. Gueniat, and M. Ammi. *Slicing techniques for handheld augmented reality*. in *IEEE Symposium on 3D User Interfaces*. 2014. Minneapolis, USA: IEEE. 39-42.
6. Lusseyran, F., J. Basley, F. Gueniat, and L. Pastur. *Pertinence des champs bidimensionnels dans l'analyse des phénomènes instationnaires tridimensionnels*. in *Congrès Français de Mécanique*. 2013. Bordeaux, France. 1-6.
7. Lusseyran, F., C. Douay, L. Pastur, J. Basley, and T. Faure. *An overview of the centrifugal instabilities experimentally observed in an incompressible open cavity flow*. in *European Fluid Mechanics Conference*. 2014. Copenhague, Denmark. 1.
8. Nore, C., J.-L. Guermond, J. Léorat, and F. Luddens. *Effet dynamo dans des géométries cylindriques*. in *Symposium de Génie Électrique 2014*. 2014. Cachan, France. 3.
9. Nore, C., J. Léorat, J.-L. Guermond, L. Cappanera, and F. Luddens. *Dynamo action in precessing cylinders*. in *PAMIR International Conference on Fundamental and Applied MHD*. 2014. Riga, Lettonie. 5.
10. Pellerin, S. and W. Daussin. *Simulation numérique d'un écoulement au-dessus d'une rampe à l'aide de la méthode des frontières immergées*. in *Congrès Français de Mécanique*. 2013. Bordeaux. 1-6.
11. Pivot, C., T. Duriez, C. Douay, L. Pastur, F. Lusseyran, and C. Letellier. *Toward time-delayed feedback control in an open cavity flow*. in *First international conference in numerical and experimental aerodynamics of road vehicles and trains*. 2014. Bordeaux, France. 2.
12. Reyt, I., H. Bailliet, D. Baltean, V. Daru, J.-C. Valière, and C. Weisman. *Influence de la propagation non-linéaire et de l'inertie sur le vent acoustique*. in *Congrès Français de Mécanique*. 2013. Bordeaux, France. 6p.
13. Tenaud, C., M.A. Puscas, V. Daru, A. Ern, C. Mariotti, and L. Monasse. *3D conservative coupling method between a compressible flow and a deformable structure*. in *International Conference on Coupled Problems in Science and Engineering, An Eccomas Thematic Conference*. 2013. Ibiza, Spain. 1-11.

14. Wang, Y., M. Baboulin, J. Dongarra, J. Falcou, Y. Fraigneau, and O. Le Maitre. *A parallel solver for incompressible fluid flows*. in *International Conference on Computational Science*. 2013. Barcelona, Spain: Elsevier. 439-448.

Conferences without proceedings, workshops

1. Basley, J., L. Pastur, F. Lusseyran, and J. Soria. *Reconstruction Of wavelike three-dimensional coherent structures through time-resolved planar measurements*. in *EUROMECH European Turbulence Conference*. 2013. Lyon, France.
2. Douay, C., L. Pastur, and F. Lusseyran. *About the nature of a secondary phenomenon inside a cavity shear flow*. in *EUROMECH European Turbulence Conference*. 2013. Lyon, France.
3. Gao, Z., B. Podvin, A. Sergent, S. Xin, P. Le Quéré, and L.S. Tuckerman. *On the transition to chaos of natural convection between two infinite differentially heated vertical plates*. in *Annual Meeting of the APS Division of Fluid Dynamics*. 2013. Pittsburgh, USA.
4. Gueniat, F., L. Pastur, and F. Lusseyran. *Shear layer modes competition in open cavity flow: experimental and numerical exploration of 3D features through a 3D DMD analysis*. in *International Symposium Bifurcations and Instabilities in Fluid Dynamics*. 2013. Haïfa, Israël. 1.
5. Moselhy, T., L. Mathelin, and Y. Marzouk. *Tensor-based uncertainty quantification from experimental data*. in *SIAM Conference on Computational Science and Engineering*. 2013. Boston, MA, USA.
6. Nore, C., L. Cappanera, J.-L. Guermond, J. Léorat, and F. Luddens. *Dynamo action in finite cylinders*. in *European Conference on Numerical Mathematics and Advanced Applications*. 2013. Ecole Polytechnique de Lausanne, Suisse.
7. Nore, C., J.-L. Guermond, J. Léorat, F. Luddens, and R. Laguerre. *Nonlinear dynamo in a short Couette-Taylor setup*. in *18th International Couette-Taylor Workshop*. 2013. University of Twente, Pays-Bas.
8. Nore, C., H. Zaïdi, F. Bouillault, A. Bossavit, and J.-L. Guermond. *Whitney element approach for the von Kármán Sodium (VKS) experiment*. in *Conseil Scientifique International du Labex LaSIPS*. 2014. Ecole Polytechnique, Orsay.
9. Oteski, L., Y. Duguet, and L. Pastur. *Lagrangian chaos in confined two-dimensional oscillatory convection*. in *10th European Fluid Mechanics Conference*. 2014. Copenhague, Danemark.
10. Oteski, L., Y. Duguet, L. Pastur, and P. Le Quéré. *Bifurcations, synchronisations and chaos inside a two-dimensional di erentially heated cavity*. in *Bifurcations and Instabilities in Fluid Dynamics*. 2013. Haïfa, Israel. 1p.
11. Podvin, B. and Y. Fraigneau. *Numerical simulation of turbulent channel flow with wall synthetic boundary conditions*. in *EUROMECH European Turbulence Conference*. 2013. Lyon, France. 2p.
12. Puscas, M.A. *Une méthode de couplage 3D entre un fluide compressible et une structure déformable*. in *Congrès de la SMAI*. 2013. Seignosse, France.
13. Sergent, A. and B. Podvin. *Numerical investigation of flow reversals in a flat Rayleigh-Bénard cell*. in *EUROMECH European Turbulence Conference*. 2013. Lyon, France.
14. Spantini, A., L. Mathelin, and Y. Marzouk. *Rank reduction of parameterized time-dependent PDEs*. in *SIAM Conference on Uncertainty Quantification*. 2014. Savannah, GA, USA.

CORO
COnvection and ROtation

CAROLINE NORE

The group CORO investigates the dynamics of various internal or external fluid flows using numerical simulation methods. Historically the group has focused on flows driven by convection and/or rotation. Today our topics cover a broad range of hydrodynamic phenomena, the main focus being on flow instability and the associated path to turbulence. Instability sources include buoyancy, Lorentz force, wall friction, surface tension, etc.

Thermal convection is important both for industrial or environmental applications and from a fundamental point of view. Applications include thermal engineering for construction, cooling, crystal growth, drying of thin films, thermoacoustic engines and refrigerators. Strong convection flows are turbulent and their numerical simulation requires the use of Large Eddy Simulation approaches that have been validated against Direct Numerical Simulations. Regarding the more fundamental aspects, we investigate the influence of the coupling between Boussinesq-type convection and other effects: wall shear, capillary forces, evaporation.

Another strong component of the research in CORO deals with flows driven by rotation and/or shear. Vortices are found throughout in the wake of rotating devices such as propellers, wind-turbines and helicopter rotors; the study of the three-dimensional instabilities of helical vortices is a prerequisite for control strategies. Abrupt transition to turbulence in near-wall flows strongly affects the viscous drag and energetic performances in the context of aeronautics and oil transport. This phenomenon is investigated numerically in plane Poiseuille flow and boundary layer flow flow. Numerical prediction of bifurcations in rotating cylindrical cavities is another long-standing activity within CORO. During the last years, this topic has been extended to free surface flows, as well as to electrically conducting fluids. Dynamo action, namely the conversion of kinetic energy into magnetic energy, has been demonstrated numerically in wave-like flows and in different configurations inside finite containers: precessing containers and rotating impellers or walls. A new multiphase module has been added in the in-house MHD code and used to study Liquid Metal Batteries.

In parallel to understanding the physical properties, the group is also actively involved in the development of cutting-edge numerical tools. The various numerical codes available are based on the following methods: spectral, finite differences, finite volumes and finite elements, adapted to the sometimes complex geometries under study. The treatment of boundary conditions is a difficult challenge in open geometries or in confined geometries in the presence of a magnetic field. New methods under development include the design of low-order reduced models and tracking of passive tracers.

Research activities

Topic 1 - Convection

__A. Sergent__, J. Chergui, V. Daru (AERO), Y. Fraigneau, P. Le Quéré, L. Martin Witkowski, B. Podvin (AERO), C. Weisman, D. Bălțean-Carlès, I. Delbende, Y. Duguet, PhD students: Z.L. Gao, C. Garnier, L. Ma, L. Oteski, H.L. Tran, A. Castillo, L. Cadet

Different configurations of buoyant convection flows, such as differentially heated convection, Rayleigh-Bénard convection, buoyant jet in a confined cavity and chimney flows, as well as coupling with thermoacoustic effects, are studied numerically. Instabilities and mixing properties are investigated for a large range of physical parameters. This requires accurate algorithms and turbulent closure models as well as challenging numerical simulations.

Bifurcations, mixing, transition and turbulence in differentially heated flows

The onset of chaos in the flow of air inside a differentially heated vertical plane channel is studied numerically (Ph.D thesis of Z. Gao) using a spectral DNS code developed at LIMSI. The successive bifurcations are analyzed as the Rayleigh number increases, and a typical 3D flow pattern is evidenced which consists of a convection roll with oblique vorticity braids. The chaotic flow dynamics inside a bi-periodic minimal flow unit is described and the corresponding physical mechanisms are identified. Some of the flow key features, such as chaotic oscillations and intermittency, can be captured by a low-order model (collab. B. Podvin, P. Le Quéré and A. Sergent at LIMSI, S. Xin at CETHIL and L. Tuckerman at PMMH).

Large scale intermittency in turbulent Rayleigh-Bénard flow is investigated in a 2D square cell using a spectral DNS code and Proper Orthogonal Decomposition technique. Two types of reversals involving corner flow growth and pattern rotation have been evidenced. Three principal modes were identified: a single-roll, large-scale circulation, a quadrupolar flow, and a horizontal double-roll symmetry-breaking mode. Analysis of the interaction coefficients between the spatial modes leads us to suggest a three-dimensional model for the reversals, based on the interaction of the three principal modes with the addition of noise (collab. B. Podvin and A. Sergent).

Lagrangian and Eulerian transition to chaos in a closed differentially heated cavity

The route to chaos is also investigated numerically inside a closed two-dimensional differentially heated air-filled cavity with a finite height-to-width ratio of two. Confinement implies a recirculating flow, and the presence of a stratified core supports internal oscillations of the flow. As the Rayleigh number is increased, a sequence of oscillatory bifurcations leads to quasi-periodic regimes interspersed with synchronization windows where the dynamics is periodic, and eventually the flow becomes chaotic. The dynamics of passive Lagrangian tracers is also investigated numerically in order to quantify chaotic mixing inside the same cavity flow, with an emphasis on the time-periodic regime. Large chaotic mixing zones are predicted by the computation of Melnikov functions associated with homoclinic/heteroclinic trajectories of the base flow. Transition towards complete mixing occurs via the resonance of streamlines, which demonstrates that the first oscillatory regime of the flow is sufficient to induce complete two-dimensional mixing within the whole cavity (PhD thesis of L. Oteski funded by Airbus Group, formerly EADS foundation).

Buoyant convection modeling: chimney and buoyant jet

For buoyant flows in open or semi-infinite configurations, prescription of the appropriate boundary conditions on the frontiers of the computational domain is a key issue for the relevance and the accuracy of numerical simulations. An asymmetrically heated vertical channel (chimney) is a prototype for such flows (Ph.D thesis of C. Garnier). The first reference solutions have been computed by considering the chimney immersed in a very large tank in order to evaluate the relevance of various types of boundary conditions for the top and bottom interfaces of the chimney. Eventually a new set of boundary conditions has been proposed to model a chimney in free surroundings (collab. P. Le Quéré, Y. Fraigneau and A. Sergent).

Knowledge of dispersion and mixing mechanisms for hydrogen in confined air-filled cavities is important for the safety of all hydrogen-based systems. Using a 2D numerical model developed for a binary mixture at constant pressure (Ph.D thesis of H.L. Tran), a laminar starting plume of a glycerol-water mixture is considered as a validation test case using comparison with experimental data [Rogers & Morris 2009]. A modified scaling law for the ascent velocity is proposed as a function of a modified Reynolds number. For a helium-air mixture, a cylindrical cavity is considered to model the CEA experimental set-up [Cariteau & Tkatschenko 2012]. By comparison with experimental data and benchmark solutions, the effect of the axisymmetry assumption has been evidenced (collab. P. Le Quéré and A. Sergent with G. Bernard-Michel at CEA and A. Davaille at FAST).

Thermal convection and thermoacoustics

The influence of a resistive load on the starting performance of a standing-wave thermoacoustic engine is investigated numerically (PhD Thesis of L. Ma). The model used is based on a low Mach number assumption; it couples the two-dimensional nonlinear flow and heat exchange within the thermoacoustic active cell with one-dimensional linear acoustics in the loaded resonator (collab. D.Bălțean-Carlès, I. Delbende, C. Weisman, with L. Bauwens, University of Calgary). For a given engine geometry, prescribed temperatures at the heat exchangers, prescribed mean pressure and prescribed load, the results from the numerical simulation include the evolution of the acoustic pressure inside the active cell. This signal is then analyzed by extracting the growth rates and frequencies of the dominant modes. For a given load, the most unstable mode is identified, as well as the corresponding critical temperature ratio between heater and cooler. A predictive stability diagram is obtained by varying the load. The flow dynamics inside the active cell is also studied, showing vortex generation at the edges of heat exchangers and in the gap between the stack and the heat exchangers, with a strong influence on heat transfer.

In thermoacoustic devices, an important nonlinear phenomenon, responsible for reducing their efficiency, is acoustic streaming. Rayleigh streaming refers to the second order mean velocity generated by viscous effects associated with the solid surface/acoustic wave interaction. Numerical simulations of the compressible Navier-Stokes equations in closed waveguides are performed using high resolution finite difference schemes developed at LIMSI (collab. D. Bălțean-Carlès, V. Daru and C. Weisman). Two geometries are investigated: closed two-dimensional channels and cylindrical axisymmetric waveguides. A plane standing wave is excited inside the guide and the associated acoustic streaming is investigated by averaging the solution over the fundamental acoustic period. The numerical results show that for high intensity waves, when the streaming motion itself is nonlinear (fast streaming), the outer streaming cells are deformed, their centers are pushed towards acoustic velocity nodes until additional counter-rotating vortices are generated near the acoustic velocity anti-nodes. This mechanisms matches experimental results obtained using LDV (collab. Ida Reyt, H. Bailliet, J.-C. Valière from Institut Pprime, Poitiers). In order to find the mechanism responsable for this complex behavior, a direct computation of the streaming flow from the time- averaged equations is in progress.

Topic 2 - Interfacial flows

*C. Dang Vu- Delcarte, L. Martin Witkowski, **C.T. Pham**. PhD students and Post-docs fellows: L. Kahouadji*

Thermal and/or mass gradients on the free surface of a fluid give rise to inhomogeneity of surface tension (capillary forces) which can generate a flow in the bulk. There are many applications for natural and industrial processes such as crystal growth or mixture drying (salty lakes, painting, inking or packaging). The moving contact line between two immiscible fluids and a solid surface under evaporation (liquid coating) is studied using an analytical approach. The flow in a water drop under Leidenfrost effect is also investigated.

Thermocapillary convection

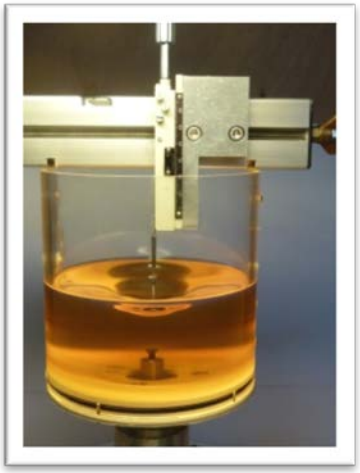
Experimental results on the drying of a Polyisobutylene/Toluene solution have shown that several convective transient regimes occur one after the other in time: at the beginning of drying, a thermal transient regime is observed followed by a solutal transient regime. The onset of convection (Bénard-Marangoni and Rayleigh-Bénard) is studied for a large range of initial thicknesses and viscosities. Two-dimensional and three-dimensional models are shown to give similar results. The 3D model is used to characterize the pattern evolution during the drying. In the case of surface tension driven convection, a method has been developed to describe the cells morphology and their time evolution (collab. C. Dang Vu-Delcarte and B. Trouette with E. Chénier at MSME-UPEMLV and B. Guerrier at FAST).

Solutal convection

During the drying of plane layers of polymer solutions, four mechanisms, based on buoyancy or surface tension, of thermal or solutal origin, can give rise to convective flow. This problem is studied numerically by using several assumptions deduced from previous experiments involving polymer solutions. The stability of the system is investigated as a function of the solutal Rayleigh and Marangoni numbers, the evaporative flux and the Schmidt number. The sensitivity of the thresholds to the initial perturbation is also analyzed. The effect of viscosity variation during drying is investigated. In this transient problem, when linear stability analysis indicates the presence of several instability mechanisms, it is necessary to invoke nonlinear arguments to establish the leading mechanism (collab. C. Dang Vu-Delcarte and B. Trouette with E. Chénier at MSME, F. Doumenc and B. Guerrier at FAST).

Free surface rotating disk flows

The free surface of the flow driven by a rotating disk in a cylindrical cavity can exhibit a variety of shapes ranging from a basic axisymmetric basin to fascinating polygons formed by the contact line on the dewetted disk. Accurate simulation of the free surface deformation is challenging while experimental measurements are still missing or incomplete. A first step has been achieved in the axisymmetric configuration. An in-house code using curvilinear coordinates has been developed and comparisons with measurements using an experimental set-up are quite satisfactory for large deformations and large density ratio (air/water) (collab. L. Martin Witkowski and L. Kahouadji).



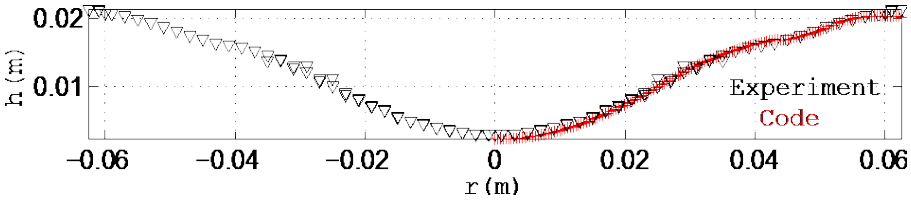


Figure:
Left: Experimental setup of free surface rotating disk flow.
Right: Comparison between numerical and experimental results. Parameters : Angular velocity 146 rpm, density 866 kg m^{-3}, dynamic viscosity of 49.5 × 10^{-3} Pa s, radius 62.5 mm and height at rest 15.5mm.

Moving contact line under evaporation

Understanding the dynamics of a moving contact line in the presence of evaporation is crucial, for instance for coating processes using drying solutions. The problem is complex since it involves both hydrodynamic and evaporative singularities at the contact lines. We suggest a model for a moving contact line under evaporation in partial or complete wetting situations, taking into account the divergent evaporative flux near the contact line. Analytical calculations together with numerical simulations lead to a generalization of the Cox-Voinov wetting laws that relate the apparent macroscopic contact angle to the speed of the contact line. In the case of complete wetting, a disjunction pressure term due to van der Waals interactions between the substrate and the liquid is considered, and the existence of a precursor film is shown. Its length and thickness are computed together with the dynamics of an evaporating wetting droplet, which depend on Hamaker constant and evaporative flux (collab. C.-T. Pham with F. Lequeux at ESPCI and L. Limat at University Paris Diderot).

Korteweg-De Vries solitons in Leidenfrost liquid cylinder

When a drop of volatile liquid is deposited on a very hot surface, it can levitate above its own vapor. This effect is called the Leidenfrost effect. Leidenfrost drops are limited in volume, and beyond a critical volume, chimneys appear inside the liquid puddle. However we show experimentally that this volume limitation can be circumvented by creating large liquid volumes using curved substrates. By considering long straight channels with curved bottom, we show that solitary surface waves can propagate along the channel and we identify them as Korteweg-de Vries solitons of negative amplitude. Their theoretical properties can be recovered both analytically and experimentally (C.-T. Pham in collaboration with S. Perrard and L. Deike at University Paris Diderot).

Topic 3 - Rotating and shear flows

*I. Delbende, Y. Duguet, **L. Martin Witkowski**, P. Le Quéré, O. Daube, W. Herreman, PhD students : C. Selçuk*

We study flows for which the effects of rotation and/or shear are dominant and the main focus is numerical prediction of instability thresholds, bifurcations and abrupt transition to turbulence.

Simulation of flows with a helical symmetry

Helical vortices are found in many industrial applications ranging from wind turbine to helicopter rotor wakes. The conception of such devices or the improvement of their performance requires an in-depth comprehension and description of the flow. The code HELIX developed at LIMSI solves the Navier-Stokes equations with built-in helical symmetry; it is used to identify quasi-equilibrium states consisting of

multiple helical vortices. The dynamics (quasi-periodic states, vortex merging events) are predicted by computing instability modes using an Arnoldi algorithm implemented within the HELIX code and simulating their nonlinear evolution (PhD thesis of C. Selçuk). The prediction of instabilities is currently being extended to full 3D modes, which requires developing a new simulation code since the streamfunction-vorticity formulation of HELIX can non longer be used in 3D.

Libration-driven multipolar instabilities

Gravitational interaction between neighboring planets induces a so-called librational motion: planets sway around some equilibrium position in a periodic manner. Combined with rapid rotation, libration can induce flows in liquid inner regions of the planets. The librational forcing can become particularly efficient when combined with multipolar boundary deformations induced for example by tidal deformations. A detailed study on libration driven multipolar instabilities is performed combining local and global stability analysis together with direct numerical simulations (collab. W. Herreman with D. Cébron and S. Vantieghem from the geophysics department of ETH Zurich).

Rotating disk flow

The flow driven by rotating disks develops instabilities (centrifugal, shear) that are generic for many industrial or geophysical configurations. Over the last two years, an experimental facility has been set up for the case of one disk rotating at the bottom of an open cylindrical cavity. The objective is to compare as accurately as possible, the thresholds of the primary bifurcation with numerical tools (linear stability analysis and three dimensional direct numerical simulation). Even for a rotating rate that does not imply large free surface deformation, the thresholds seem difficult to predict and the reasons of the discrepancy are not yet clearly identified (collab. L. Martin Witkowski with S. Poncet and E. Serre at M2P2 (Marseille)).

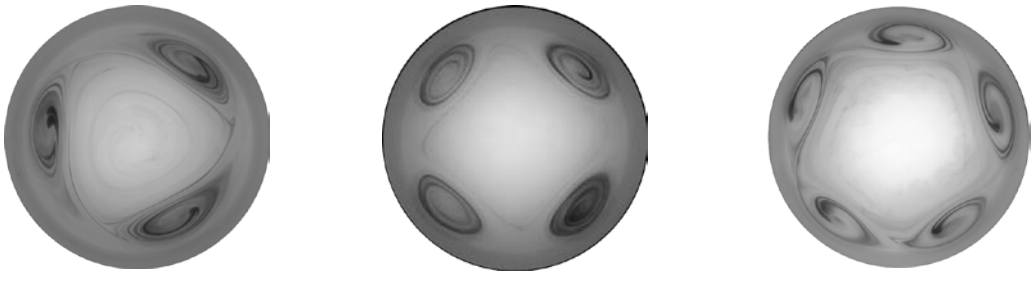


Figure: Flow structures observed experimentally in rotating disk flow.

Subcritical transition to turbulence in shear flows

Transition to turbulence in wall-bounded flows is a notoriously challenging topic. Further conceptual difficulties arise in the subcritical case, i.e. when transition occurs in the absence of linear instability of the base flow, as is the case for most canonical shear flows in the presence of solid boundaries. Two different approaches are considered, both relying on extensive spectral direct numerical simulations. The first approach, inspired by the theory of dynamical systems, relies on the identification of edge states, i.e. relative attractors sitting on the phase-space separatrix between the basins of attraction of the laminar and the turbulent state, respectively. These self-sustained coherent states appear to be invariably localised in space. Transition occurs through their spatial expansion. Current work deals with

the identification of these edge states in plane Poiseuille flow (PhD thesis of S. Acharya Neelavara) as well as in boundary layer flow with or without suction (PhD thesis of T. Khapko in collaboration with KTH Mechanics, Stockholm, Sweden and Philipps Universität Marburg, Germany). Computing time for the boundary layer case benefited from the attribution of a European PRACE price.

The second approach revolves around the spatio-temporal intermittency characterizing the onset of turbulence, and the possible formation of large-scale laminar-turbulent patterns. We suggest a mechanism for the formation of such large-scale structures such as oblique turbulent stripes in plane Couette flow and plane Poiseuille flow. It is based on a scale separation between small-scale motion and large scales associated with the viscous diffusion at the laminar-turbulent interfaces. A statistical model of spatio-temporal intermittency is also currently being developed for boundary layer flows based on cellular automata.

Topic 4 - Magnetohydrodynamics (MHD)

C. Nore, W. Herreman, PhD students and Post-docs fellows: L. Cappanera, F. Luddens, J. Varela, H. Zaidi

The motion of electrically conducting liquids couples the velocity and magnetic fields through the Lorentz force and Ohm's law and can lead to dynamo action, namely the conversion of kinetic energy into magnetic energy. We study this effect in wave-like flows and in different configurations within finite containers: precessing containers and rotating impellers or walls. A new optimization method is being tested for flows in different boxes. A new multiphase module has been added in the in-house MHD code and used to study Liquid Metal Batteries.

Multiphase magnetohydrodynamics flows

The interest for liquid metal batteries (LMBs) as a solution to meet future electrical energy storage problems is renewed with the studies of Prof. D. Sadoway's group at MIT [Kelley & Sadoway, POF 26, 2014]. In these galvanic cells, three layers of fluids (liquid metal electrode--electrolyte--liquid metal electrode) of different densities are stably stacked over each other by gravity. Intense electrical currents passing through LMBs might trigger Magneto-Hydro-Dynamical (MHD) instabilities and thus induce fluid flows that can destroy the integrity of the stratified structure of the battery. This problem is studied with our numerical MHD code SFEMaNS extended with a new multiphase MHD module (PhD thesis of L. Cappanera) that allows to simulate flows in LMBs. Excellent agreement is found between results of a detailed theoretical study and numerical computations. The figure below shows the result of direct numerical multiphase simulations of the Tayler instability in a model battery (collab. W. Herreman, C. Nore, L. Cappanera with J.-L. Guermond from Texas A&M university, USA).

Figure:
Velocity (left) and perturbed current (right) fields in a modeled Liquid Metal Battery (LMB) near short-circuit. The Tayler instability in the top liquid electrode has generated two counter-rotating vortices strong enough to wash away the fine electrolyte layer between the two electrodes. The yellow surface is the interface between the electrolyte and the bottom liquid electrode, the green surface is the interface between the electrolyte and the top liquid electrode. Results from SFEMaNS (2014)

Dynamo action in the von Kármán experiment

Other topics of the team concern the modelling of the dynamo effect in the von Kármán experiment. The study of the influence of ferromagnetic material (disks and blades) on the generation of magnetic field is continued following the SFEMaNS extensions implemented during the PhD thesis of F. Luddens. Results obtained with SFEMaNS are compared with those produced by an independent numerical code based on Whitney elements. This work was performed during the Post-doc of H. Zaidi, a new collaboration with LGEP financed by the labex LASIPS (collab. C. Nore and H. Zaidi, F. Bouillault and A. Bossavit from LGEP, Orsay, and J.-L. Guermond from Texas A&M university, USA). This study is continued with CEA, during the Post-doc of J. Varela-Rodriguez financed by an interlabex grant (collab. C. Nore and B. Dubrulle from SPHYNX, SPEC, CEA Saclay and S. Brun from P2IO, CEA Saclay).

Kinematic dynamo action by Lagrangian mean flow

It has been shown that fluctuation flows can drive dynamos through the Stokes drift associated with them. Mean fluid particle movement can thus control kinematic dynamo action at high Rm. Now, this model is extended beyond the restrictive class of fluctuation flows. It is identified under which circumstances the Lagrangian mean flow, the mean flow followed by fluid particles, can control the

dynamo. In this theoretical/numerical study, our result is also linked to Braginsky's model, which is a grand classic in dynamo theory.

Optimized dynamo action

Finally, a new topic has emerged in collaboration with ETH Zurich (PhD of L. Chen supervised by A. Jackson). Using a variational optimization algorithm inspired by [Willis, PRL 109, 2012] we study which flows can drive most efficiently a dynamo in a box with impermeable sidewalls. The case of the cubic fluid container has been studied and the method is currently extended to spherical fluid domains.

1) Solving the longstanding discrepancy between experimental and numerical results (stratification and flow) of turbulent natural convection in differentially heated cavities, by adding a full thermal coupling at walls in a pure convection 3D code.

2) Computation of large free surface deflection in a rotating flow with large density ratio (air/water) that provides clarification in the discrepancy found in the literature between various results.

3) Progress in the fundamental understanding of subcritical transition to turbulence in wall-bounded flows, via the computation of exact coherent structures.

4) Implementation of an Arnoldi algorithm within the HELIX code in order to compute the dominant instability modes of helical vortex systems such as rotor wakes, within the framework of helical symmetry.

5) Extension to multiphase flows of our in-house code for MHD flows (SFEMaNS) with applications to the Liquid Metal Batteries (LMBs). First nonlinear computations of Tayler instability in LMBs.

Staff

Permanent staff

Last name	First name	Position	Employer	HDR	Arrived	Left
Baltean	Diana	MC	UPMC			
Dang Vu	Claudine	PREM	Université Paris-Sud	HDR		
Delbende	Ivan	MC	UPMC	HDR		
Duguet	Yohann	CR1	CNRS			
Herreman	Wietze	MC	Université Paris-Sud			
Le Quéré	Patrick	DRCE	CNRS	HDR		
Martin Witkowski	Laurent	MC	UPMC			
Nore	Caroline	PR1	Université Paris-Sud	HDR		
Pham	Chi-Tuong	MC	Université Paris-Sud			
Sergent	Anne	MC	UPMC			
Weisman	Catherine	MCHC	UPMC			

PhD Students

Last name	First name	Arrived	Thesis defense	Ecole Doctorale	School / University
Cadet	Laurent	01/10/2012		La Rochelle	Université La Rochelle
Cappanera	Loïc	01/10/2012		MIPEGE	Université Paris-Sud
Castillo Castellanos	Andres Alonso	01/10/2013		SMAER	UPMC
Gao	Zhenlan	01/12/2010	18/11/2013	SMAER	UPMC
Garnier	Charles	01/09/2011	03/12/2014	SMAER	UPMC
Ma	Lin	01/10/2011	12/12/2014	SMAER	UPMC
Oteski	Ludomir	01/10/2011		MIPEGE	Université Paris-Sud
Saikali	Elie	24/11/2014		SMAER	UPMC
Selcuk	Can	01/01/2013		SMAER	UPMC
Tran	Huong-Lan	07/12/2009	30/09/2013	SMAER	UPMC

Non permanent staff

Last name	First name	Position	Employer	Arrived	Left
Hireche	Omar	MC	Ministère des affaires étrangères	14/11/2013	30/11/2013
Nehar Belaid	Kheira	EGIDE	EGIDE	30/09/2013	31/10/2013
Roussel	Olivier	Chercheur	CNRS	01/06/2013	31/05/2014
Tran	Huong-Lan	CDD IE	Université Paris-Sud	01/01/2013	31/10/2013
Tran	Huong-Lan	CDD Chercheur	CNRS	01/11/2013	31/12/2013
Varela Rodriguez	Jacobo	CDD Post-Doc	CNRS	01/09/2014	15/07/2015
Zaïdi	Houda	CDD	CNRS	01/01/2013	31/12/2013
Zaïdi	Houda	CDD	CNRS	01/01/2014	28/02/2014

Internships

Last name	First name	Arrived	Left	Prepared degree	School / University
Blin	Jérémie	17/03/2014	18/07/2014	M2 DFE	Université Paris-Sud
Bui	Trung-Thanh	07/01/2013	04/02/2013	L3 Mécanique	Université Paris-Sud
Erdogan	Eser	23/05/2013	20/07/2013	M1 Physique Appliquée et Mécanique	Université Paris-Sud
Faugaret	Antoine	15/04/2014	15/09/2014	Master 2	UPMC
Faugaret	Antoine	15/05/2013	31/08/2013	Master 1	UPMC
Gastineau	Jean	14/04/2014	31/07/2014	M1 MF2A	UPMC
He	Zeng Peng	07/01/2013	08/02/2013	L3 Mécanique	Université Paris-Sud
Jin	Zhao	07/01/2013	08/02/2013	L3 Mécanique	Université Paris-Sud
Ligeard	Bruno	18/04/2014	18/07/2014	M1 Physique Appliquée et Mécanique	Université Paris-Sud
Nathanaili	Vasjon	10/06/2013	10/08/2013	M1 MF2A	UPMC
Shao	Yinlong	20/05/2013	12/07/2013	M1	Université Paris-Sud
Tsigaridis	Emmanuelle	07/01/2013	08/02/2013	L3 Mécanique	Université Paris-Sud

Indicators of scientific notoriety

Prizes and awards

- [C. Nore], junior member of Institut Universitaire de France, section Sciences pour l'Ingénieur (2008 to 2013).

Scientific events

- [Claudine Dang-Vu Delcarte], Scientific Committee, International Marangoni Association 7, Vienna, Austria, 23-26/06/2014.
- [Y. Duguet], Main Organizing Committee, international Euromech Colloquium EC525 on 'Subcritical Transition to Turbulence' held in Cargèse, Corscia, France, on May 6th-9th 2014, including 92 participants.
- [Y. Duguet], Organizing Committee, session on *Subcritical transition in shear flows* of the 5th International Symposium on Bifurcations and shear flows" held in Haifa, Israel, July, 8-11th, 2013.
- [Chi-Tuong Pham], Scientific Committee, 16^{e} Rencontre du non-linéaire, Paris, 25-27/03/2013.
- [Chi-Tuong Pham], Scientific Committee, 17^{e} Rencontre du non-linéaire, Paris, 18-20/03/2014.
- [Chi-Tuong Pham], Organizing Committee, 16^{e} Rencontre du non-linéaire, Paris, 25-27/03/2013.
- [Chi-Tuong Pham], Organizing Committee, 17^{e} Rencontre du non-linéaire, Paris, 18-20/03/2014.
- [A. Sergent], Organization Committee, 13^{e} école thématique de Mécanique des Fluides Numériques MFN2013 on the topic « Outils et méthodes multi-échelles», Porquerolles, June 2-8 2013.

Editorial activities

- [Chi-Tuong Pham], Editor, Comptes-Rendus de la 16^{e} Rencontre du non-linéaire.
- [Chi-Tuong Pham], Editor, Comptes-Rendus de la 17^{e} Rencontre du non-linéaire.
- [A. Sergent], Regional Associate Editor, International Heat Transfer Conference 15, Kyoto, Japan, August 10-15th 2014.

Invited lectures, talks or seminars

- [D. Baltean-Carlès and C. Weisman], Invited lecture, *Modelling and numerical simulations of thermoacoustics*, as part of the 'Space trips' Summer School on thermoacoustic and space Technologies, june 17-20, 2014, French Institute, 59 Elizabetes street, LV-1050 Riga.
- [I. Delbende], Invited lecture, *Dynamics of helical vortices*, Seminar of FDY (TUD), Darmstadt, Germany, 23th April 2013.
- [Y. Duguet], invitation and funding for three weeks for the long workshop program 'Mathematics of Turbulence' held at the Institute of Pure and Applied Mathematics, UCLA, Los Angeles, California, USA in October 2014.
- [Y. Duguet], Invited Scientist for a one-month stay at Nordita Stockholm, Sweden in May 2013 during the Nordita program 'Stability and Transition'.
- [Y. Duguet], Invited lecture, International Workshop on "Collective dynamics in coupled oscillator systems" held at the Weierstrass Institute, Berlin, Germany in November 2014.
- [Y. Duguet], Invited lecture, Aristote ROC & ROM Seminar on Reduced-Order Modelling meeting in October 2014, Ecole Polytechnique, Palaiseau.

- [Y. Duguet], Invited lecture, workshop 'Nonlinear stability theory: from weakly nonlinear theory to the verge of turbulence' held at Imperial College London, March 2014, in honour of Prof. J.T. Stuart's 85th birthday.
- [Y. Duguet], Invited lecture, University of Bristol, School of Mathematics, UK in February 2013.
- [W. Herreman**],** Invited lecture, *Le rôle de la dérive de Stokes dans le problème de la dynamo*, Département de physique de l'ENS, Lyon, 8 october 2012.
- [W. Herreman], Invited lecture, *The role of fluid particle motion in kinematic dynamo action at high Rm*, Departement of geophysics ETH, Zurich, 20 march 2013.
- [C. Nore], Invited lecture, *Dynamo action in cylindrical containers*, Symposium de Génie Electrique, Cachan (France), 8-10 juillet 2014 (voir http://www.dailymotion.com/sge-conf).
- [Chi-Tuong Pham], Invited lecture, *Depression soliton wave in a Leidenfrost cylinder*, 14th Workshop on Instabilities and Nonequilibrium Structures, Viña del Mar, Chile, 9—13/12/2013.

Participation in expertise and administration of research

Ph.D and Habilitation committees

- [I. Delbende], 1 as a referee: Omar Bentata (2013): Etude expérimentale d'un anneau tourbillonnaire en fluide newtonien et non newtonien en régime faiblement inertiel. Soutenue le 20 février 2013 à l'IMFT - Université Paul Sabatier, Toulouse.
- [I. Delbende], 1 as a referee: Mohamed Ali (2014): Caractérisation et instabilités des tourbillons hélicoïdaux dans les sillages des rotors. Soutenue le 10 avril 2014 à l'IRPHE - Université Aix-Marseille.
- [I. Delbende], 1 as a examinator: Christelle Douay (2014): Etude expérimentale paramétrique des propriétés et transitions de l'écoulement intra-cavitaire en cavité ouverte et contrôle de l'écoulement. Soutenue le 4 juin 2014 au LIMSI - UPMC.
- [D. Baltean-Carlès, I. Delbende, C. Weisman], 1 as co-direcors (2014): Modélisation et simulation des effets non linéaires et multidimensionnels d'un moteur thermoacoustique : influence d'une charge résistive. Soutenance prévue le 12 décembre 2014 au LIMSI - UPMC.
- [Y. Duguet], 1 as an examinator of a PhD defense committee held at IMFT, University of Toulouse in December 2014.
- [C. Nore], 1 as an examinator : Florimond Guéniat (2013) : Détection de Structures Cohérentes dans des Écoulements Fluides et Interfaces Homme-Machine pour l'Exploration et la Visualisation Interactive de Données Scientifiques. Soutenue le 6 décembre 2013 au LIMSI (Paris-Sud).
- [C. Nore], 1 as a president : Guillaume Prigent (2013) : Modélisation et simulation numérique d'écoulements diphasiques pour la microfluidique. Soutenue le 24 janvier 2013 au LIMSI (Paris-Sud).
- [C. Nore], 1 as a referee: Jorge A. Morales (2013) : Confined magnetohydrodynamics applied to magnetic fusion plasmas. Soutenue le 01 octobre 2013 au LMFA - Ecole Centrale de Lyon, Ecully.
- [C. Nore], 1 as a referee of HdR: Sébastien Poncet (2014) : Instabilities, turbulence and heat transfer in confined rotating flows. Soutenue le 05 février 2014 à la Faculté des Sciences, Université d'Aix-Marseille.
- [Chi-Tuong Pham], 1 PhD committee (Paul Boniface, Paris Diderot) as a member 27/05/2014.
- [A. Sergent], 3 as co-advisor.

Member of selection juries

- C. Nore was president of Comité de Sélection Maître de Conférences CNU 60 in May 2013, Paris-Sud University (poste 4143).

- C.-T. Pham was member of Comité de Sélection Maître de Conférences CNU 60 in May 2013, Paris-Sud University (poste 4142).
- C.-T. Pham and A. Sergent were members of Comité de Sélection Maître de Conférences CNU 60 in May 2013, Paris-Sud University (poste 4143).
- C.-T. Pham was member of Comité de Sélection Maître de Conférences CNU 34 in May 2013, UPMC (poste 1361).
- A. Sergent was member of Comité de Sélection Maîtres de Conférences CNU 60/62 at Université d'Evry Val d'Essonne, May 2013.
- A. Sergent was member of Comité de Sélection Maîtres de Conférences CNU 60/62 at Université de Poitiers, May 2013.

Position in Scientific Councils or Associations or Networks

Dissemination and scientific outreach

- [C. Weisman and D. Baltean-Carlès], CMEP program 10MDU809 (P. Le Quéré heads up the program) for a French-Algerian collaboration on «A numerical and experimental study of thermoacoustic systems» (2010-2014), within the framework of the Hubert Curien Tassili program, (8840 € in 2010, 10535 € in 2011, 8885 € in 2012, 9705 € in 2013 for covering travel and sustenance of the Algerian partners in France : Omar Hireche, Kheira Nehar Belaid (2012, 2013), Sid Ali Litim (2010,2011), Miloud Abidat).

Dissemination and vulgarization

- D. Baltean-Carlès was supervisor of classe préparatoire students (TIPE).
- I. Delbende is supervisor of classe préparatoire students (TIPE).

Teaching activities and duties in relation to research

- [I. Delbende], co-director of the lecture series "Modélisation et Simulation en Hydrodynamique" in the speciality "Mécanique des fluides : fondements et applications" of the Master "Sciences de l'Ingénieur" at UPMC.
- [C. Nore], co-director of the Master Physique Appliquée et Mécanique (Master PAM) of University Paris-Sud.

Research conventions and contracts

Starting date	Ending date	Acronym	Catégorie	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/03/13	15/01/14	Tassili	Collaboration de recherche	Ministère des affaires étrangères & européennes	Le Quéré Patrick	Le Quéré Patrick	International	1 845	
01/01/14	31/12/15	Transturb	Collaboration de recherche	CNRS	Duguet Yohann	Duguet Yohann	International	10 000	collaboration avec JSPS
01/01/13	31/12/16	HELIX	Collaboration de recherche	ANR	Leweke Thomas	Delbende Ivan	National	141 681	Prog non thématique
01/09/11	31/08/15	PLASBorDDIAM	Collaboration de recherche	ANR	Gicquel Alix	Le Quéré Patrick	National	115 544	Prog non thématique
01/01/13	28/02/14	Fer-VKS	Collaboration de recherche	Lasips	Nore Caroline	Nore Caroline	National	50 000	
01/09/14	15/07/15	VKS Star	Collaboration de recherche	Interlabex 2012	Dubrulle Bérengère	Nore Caroline	National	50 000	
18/12/13	18/01/14	GAMELAN n°1	Contrat de prestations de service	CEA	Sergent Anne	Sergent Anne	Industriel	14 000	
15/12/11	14/12/14	Bourse de thèse	Autre	EADS	Duguet Yohann	Duguet Yohann	Industriel	132 000	
01/01/14	31/12/14	Euromech Colloquim EC565	Autre	Lasips	Duguet Yohann	Duguet Yohann	National	2 000	Soutien Colloque

- Y. Duguet is Principal Investigator of the JSPS-CNRS collaboration with Japan along with G. Kawahara (University of Osaka, Japan), grant for the period 2014-2015: 20 kEuros.
- Y. Duguet is Principal Investigator of the Project 'Mélange chaotique par les structures cohérentes des écoulements transitionnels' founded by the Airbus Group, formerly EADS Foundation), grant : 130 kEuros including one PhD grant.
- Y. Duguet got 11 M CPU hours of computing time via the attribution of a PRACE project DECI-11 FLOCS (2014)

Valorisation

Patents, software, licence agreements…

Licence agreement	Starting date	Ending date	Licensee	Resp. for LIMSI	Comment
SUNFLUIDH_EDU	09/12/2012	08/12/2015	UPMC	Martin Witkowski Laurent	Student version of SUNFLUIDH
HELIX	28/02/2013	27/02/2016	TU Darmstadt (D)	Delbende Ivan	

Scientific publications

Doctoral theses and HdR

1. Gao, Z., *Transition to chaos of natural convection between two vertical differentially heated plates* 2014, thèse de l'UPMC. Soutenue à Orsay, France, le 18/11/2013, 158 p.
2. Garnier, C., *Modélisation numérique des écoulements ouverts de convection naturelle au sein d'un canal vertical asymétriquement chauffé* 2014, thèse de l'UPMC. Soutenue à Orsay, France, le 2014-12-03, 207 p.

3. Tran, H.-L., *Numerical modeling of natural convection of binary mixtures: case of a helium buoyant jet in an air-filled enclosure* 2013, thèse de l'Université Pierre et Marie Curie. Soutenue à Orsay, France, le 30 septembre 2013, 1-147 p.

Articles in peer reviewed scientific journals

1. Brethouwer, G., P. Schlatter, Y. Duguet, D.S. Henningson, and A. Johansson, *Recurrent bursts via linear processes in turbulent environments.* Physical Review Letters, 2014. **112**: pp.4.
2. Cebron, D., S. Vantieghem, and W. Herreman, *Libration-driven multipolar instabilities.* Journal of Fluid Mechanics, 2014. **739**: pp.502-543.
3. Daru, V., D. Baltean, C. Weisman, P. Debesse, and G. Gandikota, *Two-dimensional numerical simulations of nonlinear acoustic streaming in standing waves.* Wave Motion, 2013. **50** (5): pp.955-963.
4. Delbende, I., B. Piton, and M. Rossi, *Merging of two helical vortices.* European Journal of Mechanics - B/Fluids, 2014. pp.10.
5. Desrayaud, G., E. Chénier, A. Joulin, A. Bastide, B. Brangeon, J.-P. Caltagirone, Y. Chérif, R. Eymard, C. Garnier, S. Giroux-Julien, Y. Harnane, P. Joubert, N. Laaroussi, S. Lassue, P. Le Quéré, R. Li, D. Saury, A. Sergent, S. Xin, and A. Zoubir, *Benchmark solutions for natural convection flows in vertical channels submitted to different open boundary conditions.* International Journal of Thermal Sciences, 2013. **72**: pp.18-33.
6. Doumenc, F., E. Chénier, B. Trouette, T. Boeck, C. Dang Vu, B. Guerrier, and M. Rossi, *Free convection in drying binary mixtures: solutal versus thermal instabilities.* International Journal of Heat and Mass Transfer, 2013. **63**: pp.336-350.
7. Duguet, Y., A. Monokrousos, L. Brandt, and D.S. Henningson, *Minimal transition thresholds in plane Couette flow.* Physics of Fluids, 2013. **25** (8): pp.084103_1-084103_23.
8. Duguet, Y. and P. Schlatter, *Oblique laminar-turbulent interfaces in plane shear flows.* Physical Review Letters, 2013. **110**: pp.034502_1-034502_4.
9. Gao, Z., A. Sergent, B. Podvin, S. Xin, P. Le Quéré, and L.S. Tuckerman, *Transition to chaos of natural convection between two infinite differentially heated vertical plates.* Physical Review E, 2013. **88** (2): pp.023010_1-023010_18.
10. Guermond, J.-L., J. Léorat, F. Luddens, and C. Nore, *Remarks on the stability of the Navier–Stokes equations supplemented with stress boundary conditions.* European Journal of Mechanics - B/Fluids, 2013. **39**: pp.1-10.
11. Hollerbach, R., C. Nore, P. Marti, S. Vantieghem, F. Luddens, and J. Léorat, *Parity-breaking flows in precessing spherical containers.* Physical Review E, 2013. **87** (5): pp.053020_1-053020_9.
12. Jackson, A., A. Sheyko, P. Marti, A. Tilgner, D. Cébron, S. Vantieghem, R. Simitev, F. Busse, X. Zhan, G. Schubert, S. Takehiro, Y. Sasaki, Y.y. Hayashi, A. Ribeiro, C. Nore, and J.-L. Guermond, *A spherical shell numerical dynamo benchmark with pseudo-vacuum magnetic boundary conditions.* Geophysical Journal International, 2014. **196** (2): pp.712-723.
13. Kahouadji, L. and L. Martin Witkowski, *Free surface due to a flow driven by a rotating disk inside a vertical cylindrical tank: Axisymmetric configuration.* Physics of Fluids, 2014. **26** (072105): pp.17.
14. Khapko, T., Y. Duguet, T. Kreilos, P. Schlatter, B. Eckhardt, and D. Henningson, *Complexity of localised coherent structures in a boundary layer flow.* European Journal of Physics, 2014. **112**: pp.12.
15. Khapko, T., T. Kreilos, P. Schlatter, Y. Duguet, B. Eckhardt, and D.S. Henningson, *Localised edge states in the asymptotic suction boundary layer.* Journal of Fluid Mechanics, 2013. **717**: pp.R6_1-R6_11.
16. Lusseyran, F., P. Debesse, D. Baltean, and M.X. François, *Oscillating and streaming flow identification in a thermoacoustic resonator, from undersampled PIV measurements.* Meas. Sci. Technol., 2014. (25): pp.16.
17. Marti, P., N. Schaeffer, R. Hollerbach, D. Cébron, C. Nore, F. Luddens, J.-L. Guermond, J. Aubert, S. Takehiro, Y. Sasaki, Y.y. Hayashi, R. Simitev, F. Busse, S. Vantieghem, and A. Jackson, *Full sphere hydrodynamic and dynamo benchmarks.* Geophysical Journal International, 2014. **197** (1): pp.119-134.

18. Oteski, L., Y. Duguet, and L. Pastur, *Lagrangian chaos in confined two-dimensional oscillatory convection.* Journal of Fluid Mechanics, 2014. **759**: pp.489-519.
19. Podvin, B. and P. Le Quéré, *Nonlinear dynamics between two differentially heated vertical plates in the presence of stratification.* Theoretical and Computational Fluid Dynamics, 2013. **27** (1-2): pp.89-114.
20. Reyt, I., V. Daru, H. Bailliet, S. Moreau, J.-C. Valière, D. Baltean, and C. Weisman, *Fast acoustic streaming in standing waves: Generation of an additional outer streaming cell.* Journal of the Acoustical Society of America, 2013. **134** (3): pp.1791-1801.
21. Sergent, A., P. Joubert, S. Xin, and P. Le Quéré, *Resolving the stratification discrepancy of turbulent natural convection in differentially heated air-filled cavities Part II: End walls effects using large eddy simulation.* International Journal of Heat and Fluid Flow, 2013. **39**: pp.15-27.
22. Sergent, A., S. Xin, P. Joubert, P. Le Quéré, J. Salat, and F. Penot, *Resolving the stratification discrepancy of turbulent natural convection in differentially heated air-filled cavities Part I: Reference solutions using Chebyshev spectral methods.* International Journal of Heat and Fluid Flow, 2013. **39**: pp.1-14.
23. Shimizu, M., P. Manneville, Y. Duguet, and G. Kawahara, *Splitting of a turbulent puff in pipe flow.* Fluid Dynamics Research, 2014. **46**: pp.15.
24. Soucasse, L., P. Rivière, A. Soufiani, S. Xin, and P. Le Quéré, *Transitional regimes of natural convection in a differentially heated cubical cavity under the effects of wall and molecular gas radiation.* Physics of Fluids, 2014. **26** (024105): pp.23.
25. Xin, S., J. Salat, P. Joubert, A. Sergent, F. Penot, and P. Le Quéré, *Resolving the stratification discrepancy of turbulent natural convection in differentially heated air-filled cavities. Part III: A full convection–conduction–surface radiation coupling.* International Journal of Heat and Fluid Flow, 2013. **42**: pp.33-48.

Books & chapters in books

1. Pham, C.-T., É. Falcon, F. Pétrélis, and M. Lefranc, *Comptes-rendus de la 17e Rencontre du non linéaire* 2014: Non-Linéaire Publications. 166p.
2. Pham, C.-T., F. Lequeux, and L. Limat, *Dynamics of a complete wetting liquid under evaporation*, in *Without Bounds: A Scientific Canvas of Nonlinearity and Complex Dynamics*, R. G. Rubio and et al., Eds. 2013, Springer-Verlag Berlin Heidelberg. pp. 275-283.
3. Tran, H.-L., A. Sergent, G. Bernard-Michel, and P. Le Quéré, *Numerical model of laminar starting forced plumes in a cavity*, in *Green technology and sustainable development, Vol. 2,* 2014, HCMC - VNU Publishing house. pp. 445-451.

Conferences with proceedings and review committee

1. Delbende, I. and M. Rossi. *Dynamics of the three helical vortex system and instability*. in *International Conference on Aerodynamics of Offshore Wind Energy Systems and Wakes*. 2013. Lyngby, Denmark. 224-235.
2. Gao, Z., B. Podvin, A. Sergent, and S. Xin. *Chaotic dynamics of a convection roll in a highly confined, vertical, differentially heated fluid layer*. in *Rencontre du Non-Linéaire*. 2014. Paris, France. 39-44.
3. Gao, Z., B. Podvin, A. Sergent, S. Xin, and P. Le Quéré. *Period-doubling scenario and crisis-induced intermittency in natural convection between two vertical differentially heated plates*. in *Congrès Français de Mécanique*. 2013. Bordeaux, France. 6p.
4. Garnier, C., A. Sergent, Y. Fraigneau, and P. Le Quéré. *Etude numérique de l'interaction entre un canal vertical asymétriquement chauffé et son environnement extérieur*. 2014. Lyon: SFT. 8p.
5. Garnier, C., A. Sergent, Y. Fraigneau, and P. Le Quéré. *Comparative study of numerical simulations of a 2D buoyancy-driven flow in a vertical channel asymmetrically heated with or without external domain*. in *International Heat Transfer Conference*. 2014. Kyoto. 15.

6. Garnier, C., A. Sergent, and P. Le Quéré. *Modelisation et influences des conditions limites pour des écoulements 2D semi-confinés*. in *Colloque Interuniversitaire Franco-Québécois sur la Thermique des Systèmes*. 2013. Reims, France. 1-6.
7. Garnier, C., A. Sergent, and P. Le Quéré. *Optimization by kriging of a 2D vertical channel asymmetrically heated*. in *Congrès Français de Mécanique*. 2013. Bordeaux, France. 6p.
8. Ma, L., C. Weisman, D. Baltean, I. Delbende, and L. Bauwens. *Numerical simulation of flow dynamics in the periodic regime inside an idealized thermoacoustic engine*. in *PAMIR International Conference on Fundamental and Applied MHD*. 2014. Riga, Latvia. 5.
9. Nore, C., J.-L. Guermond, J. Léorat, and F. Luddens. *Effet dynamo dans des géométries cylindriques*. in *Symposium de Génie Électrique 2014*. 2014. Cachan, France. 3.
10. Nore, C., J. Léorat, J.-L. Guermond, L. Cappanera, and F. Luddens. *Dynamo action in precessing cylinders*. in *PAMIR International Conference on Fundamental and Applied MHD*. 2014. Riga, Lettonie. 5.
11. Reyt, I., H. Bailliet, D. Baltean, V. Daru, J.-C. Valière, and C. Weisman. *Influence de la propagation non-linéaire et de l'inertie sur le vent acoustique*. in *Congrès Français de Mécanique*. 2013. Bordeaux, France. 6p.
12. Shin, S., J. Chergui, D. Juric, A. Farhaoui, L. Kahouadji, L.S. Tuckerman, and N. Périnet. *Parallel direct numerical simulation of three-dimensional two-phase flows*. in *International Conference on Multiphase Flow*. 2013. Jeju, South Korea. 7p.
13. Stefani, F., T. Albrecht, G. Gerbeth, A. Giesecke, T. Gundrum, C. Steglich, and C. Nore. *Towards a precession driven dynamo experiment*. in *9th PAMIR International Conference, Fundamental and Applied MHD*. 2014. Riga, Lettonie. 5.
14. Tran, H.-L., A. Sergent, G. Bernard-Michel, and P. Le Quéré. *Numerical study of laminar starting plumes at high Schmidt number*. in *Congrès Français de Mécanique*. 2013. Bordeaux, France. 6p.
15. Tran, H.-L., A. Sergent, G. Bernard-Michel, and P. Le Quéré. *Numerical simulation of the helium dispersion in a semi-confined air-filled cavity*. in *International Conference on Hydrogen Safety*. 2013. Brussels, Belgium. 1-12.
16. Tran, H.-L., A. Sergent, G. Bernard-Michel, and P. Le Quéré. *Numerical model of laminar starting forced plumes in a cavity*. in *International Conference on Green Technology and Sustainable Development*. 2014. HoChiMinh, Vietnam. 445-451.
17. Zaïdi, H. and C. Nore. *Approche basée sur la méthode des éléments finis de Whitney : induction et effet dynamo dans une configuration de type von Kármán*. in *Symposium de Génie Électrique 2014*. 2014. Cachan, France. 4.

Conferences without proceedings, workshops

1. Cadet, L., A. Sergent, S. Xin, D. Saury, and P. Joubert. *Direct Numerical Simulation of turbulent natural convection flow at high Rayleigh numbers in a realistic differentially heated cavity*. in *World Congress on Computational Mechanics - 6th European Conference on Computational Fluid Dynamics*. 2014. Barcelona, Spain.
2. Cappanera, L., C. Nore, J.-L. Guermond, and W. Herreman. *Multiphase flow computations with MHD-code SFEMaNS*. in *European GdR dynamo*. 2014. University of Cambridge, United Kingdom.
3. Delbende, I., M. Rossi, and C. Selcuk. *Dynamics of a system of helical vortices and instability*. in *Euromech Colloquium*. 2013. Palaiseau, France.
4. Gao, Z., B. Podvin, A. Sergent, S. Xin, P. Le Quéré, and L.S. Tuckerman. *On the transition to chaos of natural convection between two infinite differentially heated vertical plates*. in *Annual Meeting of the APS Division of Fluid Dynamics*. 2013. Pittsburgh, USA.
5. Kahouadji, L., J. Chergui, D. Juric, S. Shin, and L.S. Tuckerman. *Dynamic Square Superlattice of Faraday Waves*. in *67th Annual Meeting of the APS Division of Fluid Dynamics*. 2014. San Francisco, USA.

6. Nore, C., L. Cappanera, J.-L. Guermond, J. Léorat, and F. Luddens. *Dynamo action in finite cylinders*. in *European Conference on Numerical Mathematics and Advanced Applications*. 2013. Ecole Polytechnique de Lausanne, Suisse.
7. Nore, C., J.-L. Guermond, J. Léorat, F. Luddens, and R. Laguerre. *Nonlinear dynamo in a short Couette-Taylor setup*. in *18th International Couette-Taylor Workshop*. 2013. University of Twente, Pays-Bas.
8. Nore, C., W. Herreman, J.-L. Guermond, and L. Cappanera. *Tayler instability in liquid metal columns and in liquid metal batteries*. in *European GdR dynamo*. 2014. University of Cambridge, United Kingdom.
9. Nore, C., R. Hollerbach, P. Marti, S. Vantieghem, J. Léorat, and F. Luddens. *Parity-breaking flows in precessing spherical containers*. in *14th EUROMECH European Turbulence Conference*. 2013. Lyon.
10. Nore, C., H. Zaïdi, F. Bouillault, A. Bossavit, and J.-L. Guermond. *Whitney element approach for the von Kármán Sodium (VKS) experiment*. in *Conseil Scientifique International du Labex LaSIPS*. 2014. Ecole Polytechnique, Orsay.
11. Oteski, L., Y. Duguet, and L. Pastur. *Lagrangian chaos in confined two-dimensional oscillatory convection*. in *10th European Fluid Mechanics Conference*. 2014. Copenhague, Danemark.
12. Oteski, L., Y. Duguet, L. Pastur, and P. Le Quéré. *Bifurcations, synchronisations and chaos inside a two-dimensional di erentially heated cavity*. in *Bifurcations and Instabilities in Fluid Dynamics*. 2013. Haïfa, Israel. 1p.
13. Pham, C.-T., S. Perrard, and C. Duchene. *Capillary Korteweg-de Vries solitons on a levitated cylinder*. in *Annual Meeting of the APS Division of Fluid Dynamics*. 2014. San Francisco. 1.
14. Selcuk, C., I. Delbende, and M. Rossi. *Linear stability analysis of helical vortices*. in *European Fluid Mechanics Conference*. 2014. Copenhagen, Danemark.
15. Sergent, A. and B. Podvin. *Numerical investigation of flow reversals in a flat Rayleigh-Bénard cell*. in *EUROMECH European Turbulence Conference*. 2013. Lyon, France.

TSF
Solid-Fluid Transfer

MICHEL PONS

The specificity of the Solid-Fluid Transfer group relies in its know-how in heat transfer and energetics, a field constantly revisited by new experimental techniques new materials, or new challenges (e.g. micro- and nano-scales). The Solid-Fluid Transfer group investigates varios scientific issues: two-phase flows, oscillating flows, solid/superfluid interface and micro-nano junctions, and applied convective transfers. We thus have developed experimental skills in Particle Image Velocimetry, Laser Doppler Velocimetry, Piezoelectric pressure sensors (for acoustic streaming in large-scale thermoacoustic machines), hot wires in thermal plumes, and thermal probes (Kapitza resistance in cryogenics conditions, i.e. below 2K). We also developed numerical skills, such as HPC and massively parallel divergence-free models with front-tracking for two-phase flows (massively parallel code BLUE), liquid-gas flows with weakly compressible gas, Monte-Carlo transport of phonons in micro- and nano-junctions, simulation of photovoltaic panels under low concentration, dynamic simulation of linear Fresnel concentrators for concentrated solar power, simulation of secondary refrigeration loops with two-phase slurries, and Second Law analyses of solar processes.

Our fundamental aims are: (1) to finely understand the basic phenomena involved in complex or innovative transfer problems, (2) to correctly simulate them, (3) to improve their efficiency, e.g. via intensification of heat-transfer, separation, or reduction of irreversibilities.

We thus address issues related to thermal- or energy-engineering, and try to build bridges between theoretical investigations and applications. We are involved in various applications such as heat-transfers at nano-scales, solar energy, design of superconducting cavities of particle accelerators, or flow-control by modulated heating.

The skills listed above have often been developed thanks to the precious help of other people in the Mechanical-Engineering Department, namely F. Lusseyran (AERO group) for PIV and LDV techniques, J. Chergui (CIGITA) for parallelization of numerical codes with front-tracking or with thermal problems, V. Daru and P. Le Quéré (AERO group) for numerical simulation of two-phase flows, Y. Fraigneau (CIGITA) for simulating thermal plumes around a hot wire.

As a summary, the Solid-Fluid Transfer group currently consists of two CNRS researchers, one professor, seven assistant professors, one research engineer (only half-time for the group), and five PhD students. We collaborate with various French laboratories, namely FAST, IPNO, IEF, GeePs (ex-LGEP), LadHyX, IRSTEA, CEA/IRFU, CEA/LITEN, EM2C, PMMH, Pprime, LAUM, PIMENT, RAPSODEE-ENSTIMAC, and foreign institutions like Hongik Univ. (South Korea), ETH (Zürich, Switzerland), Univ. Houari Boumediene (Algeria), Univ. Marrakech (Morocco), École Polytechnique Tunisie, Tech. Inst. Phys. Chem. Beijing, Inst. Refrig. and Cryog. Zhejiang Univ., Hangzhou (China), and MIT (USA).

Research activities

Topic 1: Two-phase flows, dynamics and transfers

M.-C. Duluc, D. Juric, *N. Grenier, A.-H. Ebo Adou, B. Xu, with contributions of V. Daru (AERO), J. Chergui (CIGITA), P. Le Quéré (CORO)*

Massively parallel DNS 3D code for multiphase flows: BLUE

BLUE has been developed by LIMSI in strong collaboration with S. Shin (Hongik Univ., Seoul, Korea), see our previous scientific reports. It has been successfully run on up to 65536 processors on the IBM BlueGene/Q machine at IDRIS with good scalability performance. The modular program structure allows for the application of the code to a wide variety of two-phase flow simulations: free-surface instabilities, flow of bubbles or drops with coalescence and breakup, thermal and species transport with phase change, droplet impact or flow around immersed solid objects for microchannel flows. We have thus been able to simulate cases of the Faraday instability with non-periodic pentagonal motifs for the interface. The Faraday problem has been extended to the spherical case with radial oscillations. BLUE has also been used for simulating oscillations in the Kelvin-Helmholtz Instability or a drop undergoing Leidenfrost levitation, thus meeting various experiments conducted at PMMH. BLUE is also the basis for collaboration contracts with Air Liquide, including an ANR project jointly proposed also with FAST.

Weakly compressible two-phase flows

Previous work on two-phase flows, liquid with weakly compressible gas, was based on the concept of dual fluid with appropriate Low Mach Number numerical scheme developed by V. Daru (AERO group); the interface was described with the Front Tracking method, which raised some difficulties with respect to mass conservation.

Recently, another approach has been tested that now uses a diffuse interface description based on a compressible two-fluid model, and overcomes those difficulties. In the new approach, both liquid and gas phases, either fully conservative, are numerically present at each space point and are modelled as one compressible medium with either stiff or smooth equation of state. A specific numerical scheme has been used that prevents from excessive numerical dissipation in the Low Mach regime, especially when the liquid is modelled with a high speed of sound . The two approaches (one dual fluid, or two fluids) were compared for some 1D, dynamic, and non-isothermal test-cases formerly developed by V. Daru and M.C. Duluc. As shown by Illustration 1, results are satisfactory. The two-fluid approach, currently being implemented in the in-house one-fluid compressible parallel platform CHORUS, will thus be extended in order to include phase change.

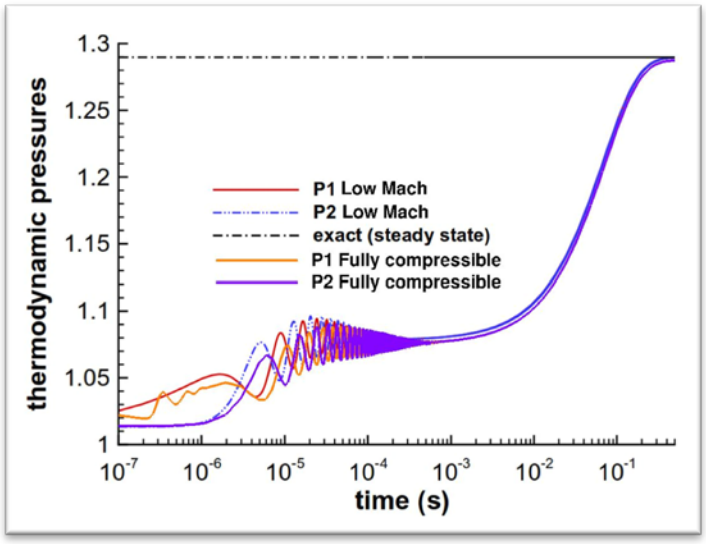


Illustration 1: Test-case of a water plug surrounded by two gas pockets, heated on only one side). Thermodynamic pressure in each gas pocket (P1 and P2).

Topic 2: Oscillating flows, dynamics and transfers

***S. Kouidri**, F. Jebali Jerbi, G. Defresne, R. Paridaens.*

We investigate the mechanisms generating secondary flows with our experimental thermoacoustic prime mover (see Illustration 2). In the previous stage, good agreement has been obtained between our LDV (Laser Doppler Velocimetry) experiments on the resonator and our numerical simulations with DeltaEC accounting for the changes in the cross sections. The analytical approach developed in the PhD thesis of R. Paridaens (see LIMSI's previous reports) is thus validated. Now, we focus our interest on the annular part of the prime mover (see Illustration 3) and on the effect of the jetpump. The first results of the LDV measurements done in 2014 have shown that the amplitude of the streaming velocity is twice smaller than in the resonator. Further theoretical investigation of the jetpump effect on the secondary flow in the annulus will be developed in the one-year LaSIPS project ENERMODEON.

Besides, the study of the thermal non-uniformity in the transverse direction is also an important issue for a better insight on the onset in thermoacoustic prime movers. Transverse temperature gradients occur in resonators, in stacks and in heat exchangers, but are ignored by the standard linear theory. In order to quantify their effects, we developed an asymptotic model generalizing the standard linear theory. Our approach does not add any assumption compared to the usual models, so that the analytical derivations introduce two generalized form functions, the viscous one f0 and the thermal one g1, that describe the effects of either type of diffusion. The amplitude and phase of those form functions are plotted vs the penetration depth δv in Illustration 4 for three values of the transverse temperature gradient. Showing that viscous diffusion tends to change the directions of the particle velocity and of the acoustic temperature related to f0 and g1.

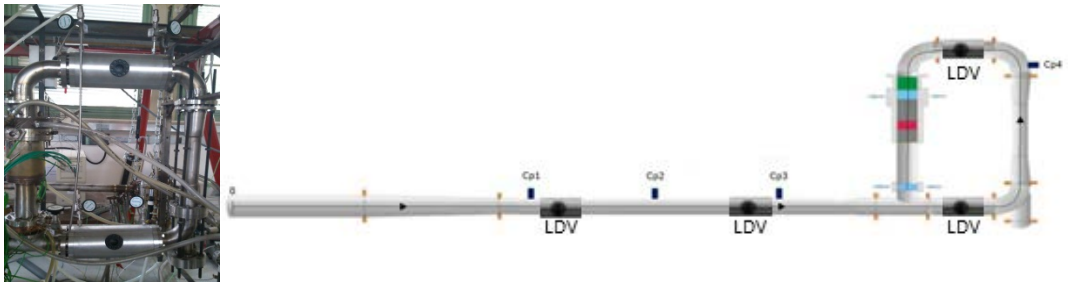


Illustration 2: Thermoacoustic prime mover

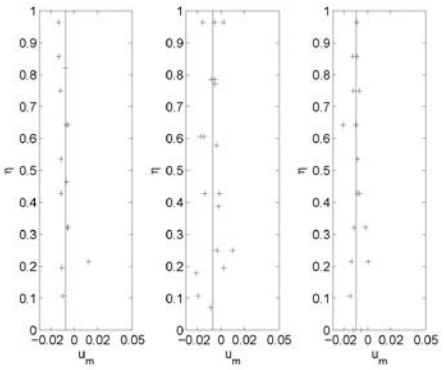


Illustration 3: Streaming velocity profiles in the annulus for resp. 165, 190 and 210W with a mean pressure of 10 bars.

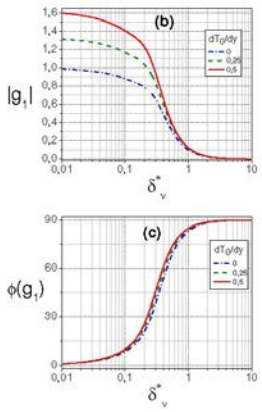


Illustration 4: Viscous and thermal form functions, resp. f_0 and g_1

Besides, the analysis of our experimental data about hot wire anemometry in oscillating flows concluded that the dynamics of heat transfer must be taken into account in order to correctly interpret the experimental signal, especially the phase difference between wire temperature and fluid velocity.

Topic 3: Heat transfer in solid/superfluid and in micro-nano junctions

***J. Amrit**, A. Ramière, L. Yu*

Our research activities focus on micro/nanoscale thermal transfer and transport at interfaces and in MEMS structures at temperatures below 2K.

Interface between Silicon and solid 4He

The analysis of our measurements of the thermal boundary (Kapitza) resistance between a silicon crystal and pressurized superfluid Helium revealed that thermal transfer at the interface is dominated by resonant scattering of phonons. This mechanism results when the phonon thermal wavelengths (2-10 nm) match surface roughnesses of the same order of magnitude. This investigation was extended above the solidification pressure of He and a preliminary measurement of the Kapitza resistance was conducted at the minimum point of the melting curve of He (0.778K and ~25 bars). The results display a sharp drop in the Kapitza resistance. This first order transition is due to a change in the He density (order parameter), which in the solid phase has phonons of transverse polarizations, thereby facilitating

coupling between transverse modes across both media. Our analysis shows that in order to fully explain the results based on the acoustic mismatch model, the extent of the critical cone within which phonons are transmitted across the interface must be spread out.

Thermal transport in Silicene: role of flexural modes

We extended our numerical studies using Monte Carlo method, of thermal transport in ribbons (Ramière et al., Nanoenergy Ltrs, 2013) to investigate phonon transport in junctions formed between suspended Silicene membranes, a structural configuration often met in thermoelectricity and applications involving graphene or silicene. Silicene is a novel 2D material (discovered in 2010) composed of Si atoms. In addition to longitudinal and in-plane transverse polarizations of phonons, the ability of Silicene to be deformed mechanically induces an out-of-plane flexural mode polarization (ZA) of phonons. Our measurements at 1K demonstrate the role of the ZA polarization. In addition, existence of a constriction thermal resistance is evidenced, with a dependence in (d/D) 1/2 where d is the junction width and D the membrane length (Ramière et al., accepted J. Phys.: Conf. Series, probably 2015). The influence of surface roughness is also taken into account. The average and frequency dependent transmission coefficients also are determined as a function of (d/D).

Thermal transport across 3D constrictions in Silicon

After Silicon ribbons, we will investigate thermal transport across 3D micro/nano-constrictions (master's and doctoral research of L. Yu).

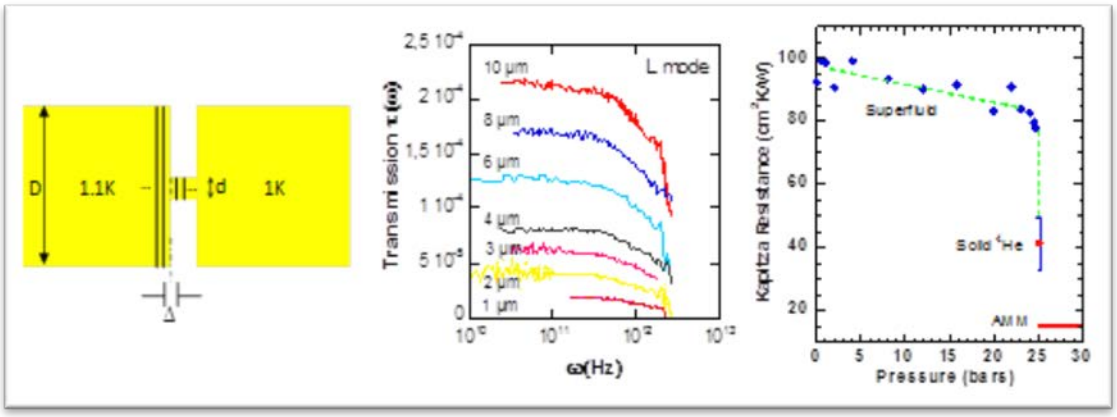


Illustration 5: Junction of width d between two suspended Silicene membranes of sides D (left), Transmission of L modes for different widths (center), Transition in the Kapitza resistance at Si crystal/4He upon solidification (right).

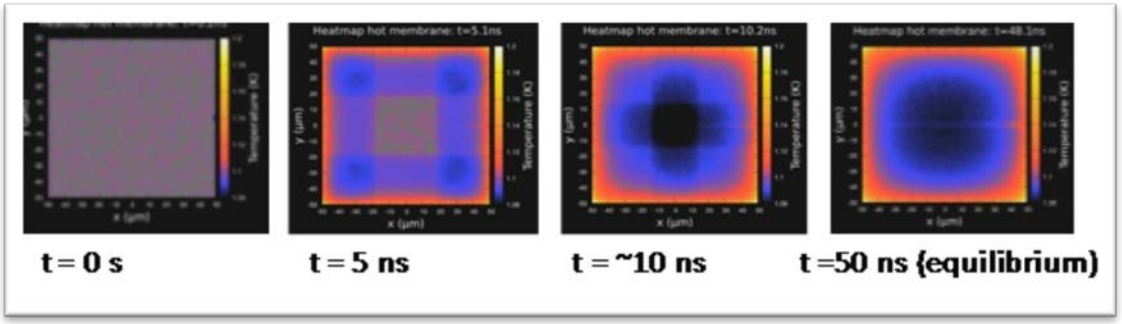


Illustration 6: Temperature evolution in the left membrane as a function of time. The temperature field depends on the magnitude of phonon scattering at the boundary and on the presence of the junction on the right side.

Topic 4: Applied convective transfers

***M. Pons**, V. Bourdin, M.-C. Duluc, M. Jarrahi, G. Defresne, M. Firdaouss, E. Tapachès, M. Pavlov, S. Wullens.*

Unsteady laminar free convection around a modulated line heat source

We herein study the unsteady laminar free convective flow created by a linear heat source dissipating a sinusoidal heat flux $\dot{q}'(t) = \dot{q}'_0\left[1 + a\sin(2\pi ft)\right]$. An experimental set-up has been constructed: a thin platinum wire, 100 µm in diameter, is immersed in a large pool of water. Once the laminar flow around the wire heated with a constant flux $\dot{q}'_0$ is established, an additional sinusoidal heating perturbation is supplied to the wire: $\dot{q}'_0 a\sin(2\pi ft)$. The wire temperature is measured over a wide frequency spectrum, showing that the thermal behavior of the solid-fluid system is that of a low-pass-filter (Illustration 7). A simplified theoretical approximation has been derived yielding trends which are roughly consistent with the experimental data (see Illustration 7). Although inaccurate, this analytical prediction qualitatively explains why the temperature amplitude vanishes for high frequency heating perturbations.

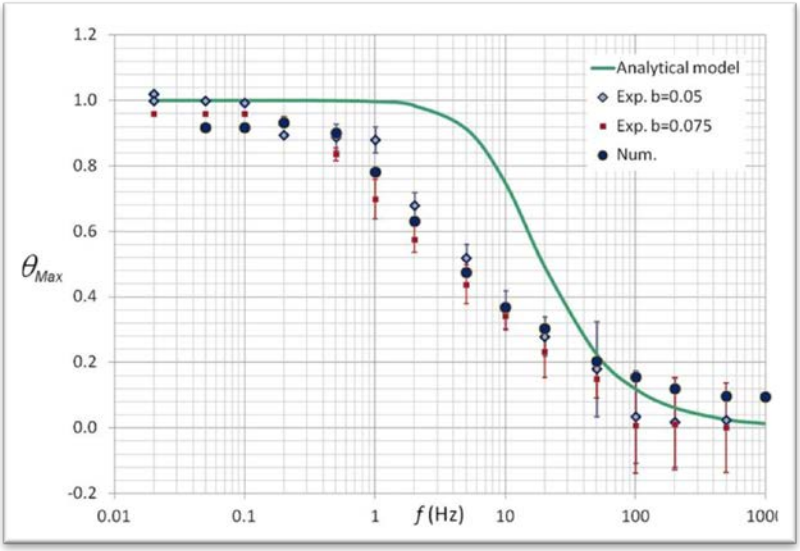


Illustration 7:
Maximum of the wire temperature (dimensionless quantity) vs frequency

Moreover, 2D cartesian numerical simulations have been performed with the in-house CFD code Sunfluidh (Y. Fraigneau, CIGITA). A good match with the experimental results is obtained (Illustration 7).

Such simulations give more insight, for instance on the penetration depth of perturbations, the amplitude of which decreases when the distance from the wire increases. Quantitative laws for correlating these three parameters are currently under identification.

In the next future, we will consider more complex configurations, such as two wires close to each other and submitted to independent heating conditions. We expect the possibility to enhance the heat flux around one wire (at least) thanks to a correctly designed heating function inside the second wire.

Mixing improvement by vortex manipulation

M. Jarrahi's former laboratory (LTN-UMR 6607, Nantes) studies multifunctional heat exchangers, mixers, or reactors in order to suggest new solutions that would increase their efficiency and reduce their size. He temporarily continued some of his previous studies on chaotic advection and on flow separation and recombination. This also led him to initiate a new collaboration with LIED (UMR 8236, Paris Diderot) on the flow characteristics and mixing quality when the fluid contains autonomously moving particles, e.g. micro-swimmers. Experimental investigation of this emerging issue should develop in the next years.

Photovoltaic (PV) panels enhanced by fixed planar reflectors - Experiments, simulations and analysis.

Increasing the solar flux received by solar absorbers or PV cells with the help of fixed mirrors is not a new idea[1]. In close collaboration with GeePs (ex-LGEP, Orsay), LMD and SIRTA (Palaiseau), we test and simulate such arrangements; this is the ALEPh project. GeePs is expert in PV semiconductor physics and PV cells characterisation; LMD and SIRTA are experts in theory and measurements of meteorological data, and in solar resource forecasting. This work combines experiments on the SIRTA's outdoor platform recording performance of so-enhanced PV panels, and two models developed by M. Pavlov for his PhD thesis. Our experiments demonstrate that daily electricity production can be enhanced by a factor ranging from 5 to 32%, see Illustration 8. In the models, the optical issues are solved either with the Infinite Row Model (IRM), based on Cartesian optics and analytical solutions, or with the Ray Tracing Model (RTM), developed under the EDStar[2] environment. In addition, the most important physical phenomena, namely electrical and thermal factors, are non-linear and coupled. The aim of the ALEPh project is to build a

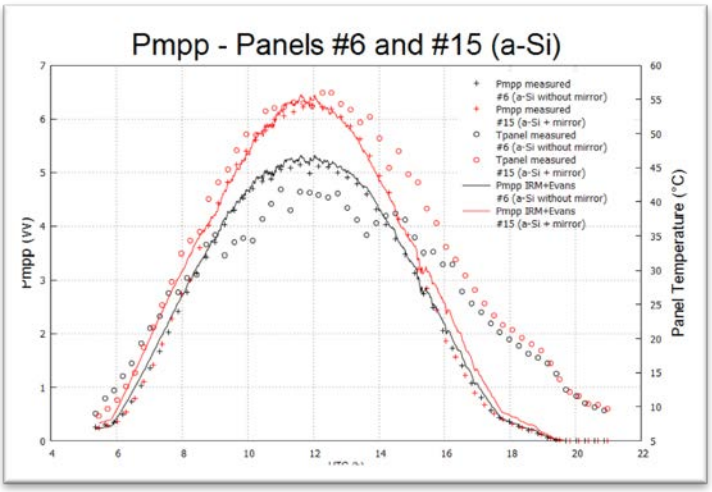


Illustration 8 : PV power (crosses) and temperature (circles) of amorphous silicon PV panels with (red) and without (black) reflector on a clear spring day (May 17-2014). Simple mirrors increase the daily production by 20%. PV power calculated with the IRM model (lines) hardly deviates from the experimental data (+).

[1] Tabor H. Stationary mirror systems for solar collectors, Solar Energy 2, 27-33 (1958)

[2] RAPSODEE-ENSTIMAC http://www.starwest.ups-tlse.fr/edstar/edstar.html

global model that would optimize geometry and materials for producing electricity in a given location and climate. Beyond reflection, absorption and transmission of visible and near-infrared radiations, calculation of the irradiation, and temperature dependence of cell efficiency, we pay special attention on insolation heterogeneities and on photocurrent mismatches that have not been studied yet.

We presently study 1) the spectral composition of solar and diffuse irradiations, and 2) the spectral and angular distributions of the optical properties of reflectors and of panels (strongly dependent on cleanliness) and their influence on the electric producible energy. Besides, the dependence of panel temperature on radiative and convective transfers has recently been addressed (D. Chigara). Calculations based on radiative calculations and phenomenological correlations for convection compare well with temperature measurements done on the back-side of the panels, even under high solar flux. All those results open the way toward simulation of panel temperature in outdoor environment.

Dynamic simulation of linear Fresnel solar receptors.

Like other solar technologies, Fresnel receptors for concentrated solar power are mainly tested in deserts. However, a significant part of mankind lives in tropical climates, where cloud coverage is frequent and chaotic, like in La Réunion island. Models based on pseudo-stationary states, which are almost the only ones reported in the literature, are no longer valid. This is why our approach, developed in close collaboration with PIMENT (St-Pierre-de-la-Réunion) in the co-supervised PhD thesis of E. Tapachés, integrates the dynamic behavior of the linear receptor. In addition, our model accounts for various non-linear effects, such as temperature-dependent thermophysical properties and heat-transfer-coefficient. As a consequence, oppositely to pseudo-stationary models, our model can simulate the behavior of the Fresnel receptor during and after cloudy events. Indeed, for the sake of material protection special procedures are required in order to maintain the fluid film-temperature under its safety maximum, even in severe situations. We have tested strategies based on feedback control with forward extrapolation and moderated by a time constant related to the current fluid velocity. Although they surely can be improved, some results are yet satisfactory, see Illustration 9. We can thus evaluate the efficiency losses due to control procedures when clouds occur and vanish. As the numerical procedure is efficient enough, operation over two years can be simulated within some hours only. As a result, such solar technology can indeed be of economic interest in isolated places like La Réunion.

Beside the PhD manuscript, some articles are in progress. Lastly, an ANR pre-project was submitted by PIMENT, LIMSI, plus RAPSODEE-ENSTIMAC, PROMES and LSS.

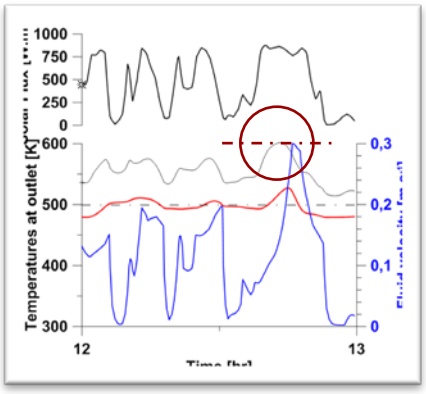


Illustration 9
Example of film temperature in the linear Fresnel receptor exactly limited to its maximal value thanks to the relevant control procedure.

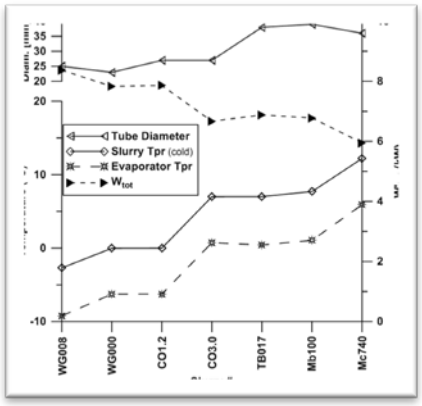


Illustration 10
Effects of slurry type on the temperature level and total electricity consumption of the cooling unit with secondary refrigerant

Use of hydrate slurries with CO2 in secondary refrigeration loops.

This new theme is developing. In order to reduce emissions of refrigerant gases, the global warming potential of which is high, more and more secondary refrigeration loops (filled with a fluid neutral with respect to the environment) replace large scale direct-cooling units e.g. in supermarkets or in hospitals (the smaller the cooling unit itself, the less it leaks). Ice slurries have been used for long a secondary refrigerant in industrial environment because they offer the advantage of large fusion enthalpy over reduced temperature glide. Currently, new types of slurries are under study, clathrate-hydrates, which are ice-like crystalline compounds, mainly made of water molecules that form cages around host molecule(s) thanks to their hydrogen-bonds. Fusion temperature of hydrate slurries lies over zero Celsius (e.g. 7 or 10°C); in addition it can be adjusted to the designed application. In 2013, LIMSI and IRSTEA obtained the PEPS project Formhydable from CNRS-INSIS-Energie. We thus constructed together a first-generation model of a very simple loop, inserted between the evaporator of the cooling unit and just one heat-exchanger where cold is finally used. Our model basically represents all the energy transport and conversion processes from the final use (in the present case, air conditioning) up the heat release to the atmosphere, i.e. including the cooling unit and its consumption of electrical power. This approach is original in the literature. Flow constraints are taken into account in order to avoid both crystal deposition (if the flow is laminar) and too high pressure drops in the loop. As a result, the loop design is adapted to the considered slurry, thus making each simulation self-consistent. Illustration 10 shows comparison of performance of various slurries ranging from glycol-water mixture to clathrate-hydrate of CO2+TBPB; it evidences the energetic advantage of hydrate slurries. In the next future (ANR project Crysalhyd, 42 months, IRSTEA, ENSTA, LIMSI, and two industrial companies), the model will be extended to more realistic configurations, with dynamic behavior and with storage.

Highlights

- Pioneer measurement of the Kapitza resistance between Silicon and solid 4He (below 0.7 K).
- Pioneer dynamic simulation of linear Fresnel solar receptors, and effect of control strategies.
- Parallel computing of two-phase flows on more than 65000 threads and invited talk at International Conference on Numerical Methods in Multiphase Flows, Darmstadt.

Staff

Permanent staff

Last name	First name	Position	Employer	HDR	Arrived	Left
Amrit	Jay	MC	Université Paris-Sud	HDR		
Bourdin	Vincent	IR2	CNRS			
Defresne	Gérard	Pr. Agrégé	Université Paris-Sud			
Duluc	Marie-Christine	MCHC	CNAM	HDR		
Firdaouss	Mouaouia	MCHC	UPMC	HDR		
Grenier	Nicolas	MC	Université Paris-Sud		01/09/2013	
Jarrahi	Mojtaba	MC	Université Paris-Sud			
Jebali Jerbi	Fathi	MC	UPMC			
Juric	Damir	CR1	CNRS	HDR		
Kouidri	Smaïne	Pr1	UPMC	HDR		
Pons	Michel	DR2	CNRS	HDR		

PhD Students

Last name	First name	Arrived	Thesis defense	École Doctorale	School / University
Ebo Adou	Ali-Higo	01/10/2012		SMAER	UPMC
Paridaens	Richard	15/09/2009	29/05/2013	SMAER	UPMC
Pavlov	Marko	01/10/2013		MIPEGE	Université Paris-Sud
Prigent	Guillaume	01/10/2009	24/01/2013	Physique Macros	Université Paris-Sud
Ramière	Aymeric	01/10/2011	26/11/2014	MIPEGE	Université Paris-Sud
Tapachès	Emeric	18/06/2012		La Réunion	Université de la Réunion
Wullens	Sébastien	01/09/2010		SISEO	Université Chambéry
Xu	Bingrui	01/10/2012		MIPEGE	Université Paris-Sud
Ebo Adou	Ali-Higo	01/10/2012		SMAER	UPMC
Paridaens	Richard	15/09/2009	29/05/2013	SMAER	UPMC

Non permanent staff

Last name	First name	Position	Employer	Arrived	Left
Bencheikh	Kamel	Bourse Pays d'origine	Université d'Alger	13/01/2014	13/02/2014
Seghiri	Abdelhak	Bourse	Gouvernement Algérien	21/01/2013	21/07/2013

Internships

Last name	First name	Arrived	Left	Prepared degree	School / University
Bernard	Théo	29/04/2013	05/07/2013	DUT	IUT Ville d'Avray
Du Pont de Romemont	Camille	03/06/2013	19/07/2013	Ingénieur	Mines ParisTech

Ndiaye	Moustapha	06/01/2014	07/02/2014	L3	Université Paris-Sud
Truche	Sylvain	24/02/2014	27/06/2014	Ingénieur	ParisTech
Yu	Lantao	01/04/2014	30/06/2014	M2	Université Paris-Sud
Bernard	Théo	29/04/2013	05/07/2013	DUT	IUT Ville d'Avray

Indicators of scientific notoriety

Prizes and awards

Invited lectures, talks or seminars

- J. Amrit: The 16th International conference on RF Superconductivity SRF 2013, 22-27 September 2013, Paris
- J. Amrit: The 6th International workshop on Thin Films and New Ideas for Superconductivity, 6-8 October 2014, Padova, Italy
- J. Amrit: Seminar "Kapitza resistance at Niobium/superfluid He interfaces", Legnaro National Laboratories (LNL-National Institute of Nuclear Physics, Legnaro, Padova, Italy, 5-8 October 2014
- S. Kouidri: Energetic Efficiency of Energy Conversion Machines, Départamento de Engenharia Mecanica, Université de Brasília, 19 août 2013, Brasilia, Brésil.
- S. Kouidri: Etude des phénomènes non linéaires dans les machines à conversion d'énergie de type thermoacoustique, 8èmes Journées Tunisiennes sur les Ecoulements et les Transferts, 29 nov-1 déc, 2013, Sousse, Tunisie.
- D. Juric, J. Chergui and S. Shin, BLUE: A Solver for Massively Parallel Direct Simulation of 3D Two-Phase Flows, International Conference on Numerical Methods in Multiphase Flows, ICNMMF-II, Darmstadt, Germany, June 30 – July 2, 2014.
- M. Pons, Second law analysis of adsorption cycles, Invited Seminar-Lecture at Kyushu University (Fukuoka, Japon), Dept Mechanics Energetics (January 22-24, 2013).

Participation in expertise and administration of research

- J. Amrit: Research Innovation Project AGIR 2014, Grenoble INP-University J. Fourier, 15th January 2014
- S. Kouidri: Scientific evaluation for Ministère de l'Enseignement Supérieur et de la Recherche, Crédit Impôt Recherche
- S. Kouidri: Scientific Committee of Laboratoire National de Métrologie et d'Essais
- M.-C. Duluc: Scientific expertise for Ministère de l'Enseignement Supérieur et de la Recherche, and for Agence Nationale de la Recherche, 2014.
- V. Bourdin: Scientific expertise for Agence Nationale de la Recherche, 2014.
- M. Pons: Scientific evaluation for ANRT (2013) and for Agence Nationale de la Recherche (2014)
- J. Amrit and M. Pons, members of CCSU 60-61-62 of Univ. Paris-Sud.

Ph.D and Habilitation committees

- J. Amrit: 1 as examinator (24/05/2013), 2 as committee member (12/12/2013, 22/09/2014), 1 as supervisor (26/11/2014)
- M.-C. Duluc: 1 as committee member (19/12/2014)
- M. Jarrahi: 1 as committee member (14/04/2014)

- S. Kouidri: 3 as examinator (9/4/2013, 5/7/2013, 1/12/2014), 2 as president (4/6/2014, 4/7/2014), 1 as supervisor (29/5/2013)
- M. Pons: 1 as committee member (11/01/2013), 1 as examinator (12/04/2013), and 1 HDR as examinator (10/06/2013).

Position in Scientific Councils or Associations or Networks

- M. Pons: Member of the Scientific Council of Société Française de Thermique.

Dissemination and scientific outreach

- M. Pons: Faut-il adopter la notion d'exergie ?, Broadcast Science Publique by Michel Alberganti, France Culture, 05/07/2013, with D. Favrat (EPFL), D. Queiros-Condé (Univ. Paris-Ouest La Défense), et V. Merigat (Science et Vie).
- M. Pons: Interview cited in L'«effet Dumas», l'énergie miracle qui ne marche que sur Facebook, by T. Schepman, Rue89 (http://rue89.nouvelobs.com/2014/12/05/l-effet-dumas-lenergie-miracle-marche-facebook-256395)
- N. Grenier organized the contribution of the ME Dept to the Fête de la Science 2014 at Univ. Paris-Sud. Several members of the group were present on the LIMSI's stand, in 2013 and 2014 as well.

Research conventions and contracts

Starting date	Ending date	Acronym	Catégorie	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/10/2014	31/03/2019	Crisalhyd	Collaboration de recherche	ANR	Fournaison Laurence	Pons Michel	National	102 072	Energie
13/04/2011	31/12/2014	Eréthiques-Jonctions	Collaboration de recherche	LaSIPS	Amrit Jairaj	Amrit Jairaj	National	38 000	Autre
01/12/2014	30/03/2016	Enermodeon	Collaboration de recherche	LaSIPS	Smaïne Kouidri	Smaïne Kouidri	National	56 700	
13/04/2011	29/02/2016	Aleph	Collaboration de recherche	LaSIPS	Jean-Paul Kleider (LGEP)	Vincent Bourdin	National	6 000	Emergence
18/12/2013	17/02/2014	BLUE	Contrat de prestations de service	Air Liquide	Juric Damir	Juric Damir	Industriel	18 000	
01/01/2013	31/12/2013	FormHydable	Collaboration de recherche	CNRS	Pons Michel	Pons Michel	National	7 500	PEPS Energie
01/01/2014	31/12/2014	Ecoulement des agents de contraste ultrasonores dans une tumeur : Etude dynamique multi-échelles	Collaboration de recherche	CNRS	Stéphanie Pitre-Champagnat	Duluc Marie-Christine	National	2 600	PEPS Energie
01/03/3013	28/02/2014		Accord de secret	Air Liquide	Pons Michel	Pons Michel	Industriel	-	
01/04/2009	30/09/2015	Kaptiza	Collaboration de recherche	IPNO	Amrit Jairaj	Amrit Jairaj	National	-	

Valorisation

Patents, software, licence agreements…			
Software registration (APP)	**LIMSI Authors**	**Date**	**Comment**
BLUE : prediction of incompressible two-phaseflows from data characterizing the flow configuration	Damir Juric - Jalel Chergui	2013	Patentibility under review

Scientific publications

Doctoral theses and HdR

1. Paridaens, R., *Analyse et caractérisation des écoulements redressés dans un moteur thermoacoustique annulaire* 2013, thèse de l'UPMC. Soutenue à Orsay, France, le 29 mai 2013, 152 p.
2. Prigent, G., *Modélisation et simulation numérique d'écoulements diphasiques pour la microfluidique* 2013, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 24 janvier 2013, 141p p.
3. Ramière, A., *Impact des rugosités sur le transport des phonons aux surfaces et interfaces à très basses températures* 2014, thèse de l'Université Paris-Sud. Soutenue à Orsay, le 26/11/2014, 140 p.

Articles in peer reviewed scientific journals

1. Baudouy, B., G. Defresne, P. Duthil, and J.-P. Thermeau, *Propriétés des matériaux à basse température.* Techniques de l'Ingénieur, 2014. **TIB596DUO** (be9811): pp.(BE9811-1 - BE9811-18).
2. Feuillebois, F., S. Tabakova, S. Radev, and V. Daru, *Entrained film of ice-water slurry with impinging supercooled water droplets.* Journal of Engineering Physics and Thermophysics, 2014. 87 (1): pp.51-68.
3. Jarrahi, M., C. Castelain, and H. Peerhossaini, *Mixing enhancement by pulsating chaotic advection, chemical engineering and processing : process intensification.* Chemical Engineering Science, 2013. 74: pp.1-13.
4. Jebali Jerbi, F., G. Huelsz, and S. Kouidri, *Acoustic velocity measurements in resonators of thermoacoustic systems using hot-wire anemometry.* Flow Measurement and Instrumentation, 2013. **32**: pp.41-50.
5. Karami, M., E. Shirani, M. Jarrahi, and H. Peerhossaini, *Mixing mechanisms by time dependent orbits in spatio-temporal chaotic advection.* Journal of Fluids Engineering, 2014. **137** (1): pp.13.
6. Khabthani, S., A. Sellier, and F. Feuillebois, *Motion of a distant solid particle in a shear ?ow along a porous slab.* Zeitschrift für Angewandte Mathematik und Physik (ZAMP), 2013. 64 (6): pp.1759-1777.
7. Lusseyran, F., P. Debesse, D. Baltean, and M.X. François, *Oscillating and streaming flow identification in a thermoacoustic resonator, from undersampled PIV measurements.* Meas. Sci. Technol., 2014. (25): pp.16.
8. Paridaens, R., S. Kouidri, and F. Jebali Jerbi, *Investigation on the generation mechanisms of acoustic streaming in a thermoacoustic prime mover.* Cryogenics, 2013. **58**: pp.78-84.
9. Rabia, A., S. Yahiaoui, M. Djabourov, and F. Feuillebois, *Optimization of the vane geometry. Applications to complex fluids.* Rheologica Acta, 2014. **53** (4): pp.357-371.
10. Raji, A., M. Hasnaoui, M. Firdaouss, and C. Ouardi, *Natural convection heat transfer enhancement in a square cavity periodically cooled from above.* Numerical Heat Transfer A, 2013. 63 (7): pp.511-533.
11. Ramière, A., J. Amrit, and S. Volz, *Role of the boundary roughness on heat transport in mesoscopic silicon ribbons at low temperatures.* Nanoenergy Letters, 2013. pp.2p.

Books & chapters in books

1. Pons, M., *Aspects thermodynamiques, bilan exergétique*, in *Livre blanc sur les recherches en énergétique des bâtiments*, Peuportier Bruno, Editor. 2013, Presses des Mines – Transvalor, Paris. pp. 65-69.

Conferences with proceedings and review committee

1. Duluc, M.-C., M. Jarrahi, Y. Fraigneau, and G. Defresne. *Natural Convection around a pulsating line heat source*. in *International Heat Transfer Conference*. 2014. Kyoto, Japan. IHTC15-9258.
2. Jarrahi, M., M. Karami, Z. Habibi, E. Shirani, and H. Peerhossaini. *Chaotic heat transfer in a pulsating twisted-curved flow with constant wall temperature*. in *Proceedings of the ASME 2014 4t^h Joint US-European Fluids Engineering Division Summer Meeting and 11th International Conference on Nanochannels, Microchannels, and Minichannels*. 2014. Chicago, Illinois, USA: ASME. 10.
3. Karami, M., M. Jarrahi, E. Shirani, and H. Peerhossaini. *Mixing enhancement in a chaotic micromixer using pulsating flow*. in *Proceedings of the ASME 2014 4t^h Joint US-European Fluids Engineering Division Summer Meeting and 11th International Conference on Nanochannels, Microchannels, and Minichannels*. 2014. chicago, Illinois, USA: ASME. 9.
4. Kouidri, S., R. Paridaens, and F. Jebali Jerbi. *Analyse phénoménologique du vent acoustique dans un moteur thermoacoustique sous pression*. in *Congrès Français d'Acoustique*. 2014. Poitiers. 7.
5. Pons, M., E. Tapachès, J. Castaing-Lasvignottes, F. Lucas, J.-J. Bézian, and F. Veynandt. *Modélisation dynamique des transferts de chaleur au sein d'un récepteur linéaire de Fresnel : application d'une régulation lors de passages nuageux*. in *Congrès Français de Thermique*. 2014. Lyon, France: SFT. 145-152.
6. Ramière, A., J. Amrit, and S. Volz. *Transition in the Kapitza resistance at Silicon/ 4He interface*. in *International conference on Low Temperature Physics LT27*. 2014. Buenos Aires, Argentina. 6.
7. Shin, S., J. Chergui, D. Juric, A. Farhaoui, L. Kahouadji, L.S. Tuckerman, and N. Périnet. *Parallel direct numerical simulation of three-dimensional two-phase flows*. in *International Conference on Multiphase Flow*. 2013. Jeju, South Korea. 7p.
8. Wullens, S., M. Pons, E. Wurtz, and Y. Fraigneau. *Étude de la transition entre convection naturelle et convection forcée dans une cavité traversante*. in *Congrès Français de Thermique*. 2013. Gérardmer, France: SFT (D. Maillet et C. Moyne). 237-244.
9. Wullens, S., M. Pons, E. Wurtz, and Y. Fraigneau. *Natural ventilation in a room, transition from natural to adverse forced convection*. in *Conference Building Simulation*. 2013. Chambéry, France. 536-543.

Conferences without proceedings, workshops

1. Bourdin, V. *Coupling optical and thermal models to accurately predict PV panel electricity production*. in *Photovoltaic Technical Conference*. 2013. Aix-en-Provence, France.
2. Bourdin, V., M. Pavlov, M. Pons, A. Migan, T. Mambrini, J. Badosa, G. Le Bars, M. Haeffelin, and J. Nassar. *Amélioration de la production photovoltaïque par l'emploi de miroirs plans*. in *Journées Nationales sur l'Energie Solaire*. 2014. Campus Universitaire de Perpignan. 4.

ILES
Information, Written and Signed Language

PIERRE ZWEIGENBAUM

A specificity of the ILES approach to natural language processing is its ultimate focus on information, i.e., the content, or meaning, conveyed by language.

Defining this information, its association with language, and how to evaluate automated systems which aim to process language in a meaningful way with respect to this information, is the goal of the Corpora and Representations topic. This is a foundational activity with a direct, concrete impact on the definition, training, and evaluation of language processing systems. ILES has produced and made available a number of annotation models, guidelines, annotated corpora, and evaluation metrics, and organized shared tasks to evaluate natural language processing systems based on these corpora.

Determining which variations in language form do or do not preserve the same information, within one language or across multiple languages, investigates a characteristic property of natural languages: the non-bijection between form and meaning. This is the topic addressed by Multilingualism and Paraphrasing.

Modeling sign language pushes further the study of the diversity of language form and contributes to the computerization of a low-resource language. Designing methods to process sign language, e.g. to generate realistic signed productions (aka virtual signer videos: see Sign Language Modelling and Processing), moreover addresses a stringent societal demand. ILES has produced a French Sign Language (LSF) corpus with a new capture technology, improved its linguistic model of sign language and produced new software for LSF generation (KAZOO).

Designing methods to extract and query information from natural language input gives access to otherwise unattainable information and knowledge.

ILES adopts a multidisciplinary approach to natural language processing, which ranges from linguistic modeling (e.g. for sign language) to statistical learning (e.g. for part-of-speech tagging and information extraction), taking into account world knowledge where relevant (e.g. to instantiate ontological concepts), including domain-specific representations (e.g. for biomedical language analysis).

In the present period, ILES has attracted a new member, an Assistant professor who decided to host his research activity in LIMSI, and received an invited researcher from Japan for six months and one from the United States for two one-month periods.

Close to half its PhD students had a foreign nationality, as well as 4 / 10 of its post-docs

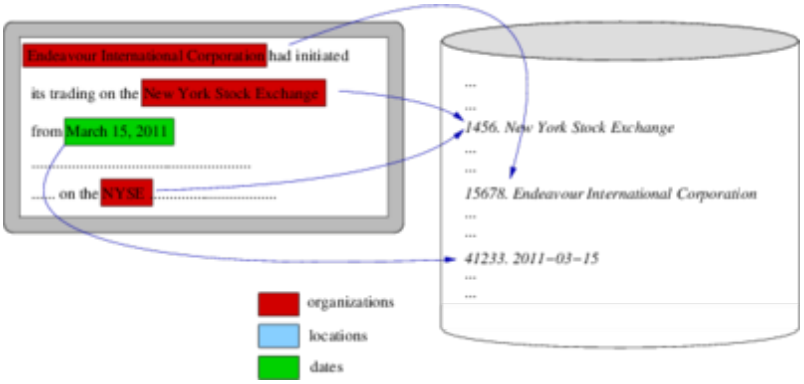
Research activities

Topic 1: Corpora & Representations

P. Paroubek, C. Grouin, M. Asadullah, A. Fraisse, M. Delaborde, A. Braffort, M. Filhol, T. Hamon, A. Max, V. Moriceau, A. Névéol, X. Tannier, A. Vilnat, P. Zweigenbaum;

The theme Corpora & Representations is about the study of linguistic events as they appear in the graphical and signed representations used by humans to communicate. The artifacts that support

our research investigations are corpora, i.e. document collections, gathered according to a specific work hypothesis. Corpora can be of various origins: speech transcriptions, books, articles, newspapers, reports, Web pages, blogs, microblogs, sign language videos, etc. Defining the target representation for a given Natural Language Processing task (e.g. part-of-speech tagging, parsing, named entity recognition, semantic indexing, opinion mining, etc.) is a foundational step in the study of the considered processing task and of its linguistic underpinnings. Creating annotated corpora according to scientifically motivated guidelines provides indispensable material not only for system development, training, or evaluation but also for teaching and contributing to the store of general scientific knowledge (Fig A). In particular corpora are instrumental in designing evaluation campaigns, which play a key role for identifying promising new research directions at the national and international levels. ILES has a track record of designing reference annotated corpora and organizing evaluation campaigns based on these corpora; our expertise in this domain gained us collaborations both in academia (CHIST-ERA/uComp project or national series of open national evaluation campaign on text mining DEFT where industrialists participate) and industry (SYSTEMATIC FUI-13/PROJESTIMATE, CAP DIGITAL FUI-15/SONAR and FSN AAP-3 Big Data/REQUEST). Note that information about sign language corpora is provided in the "Sign Language Modeling and Processing" section.



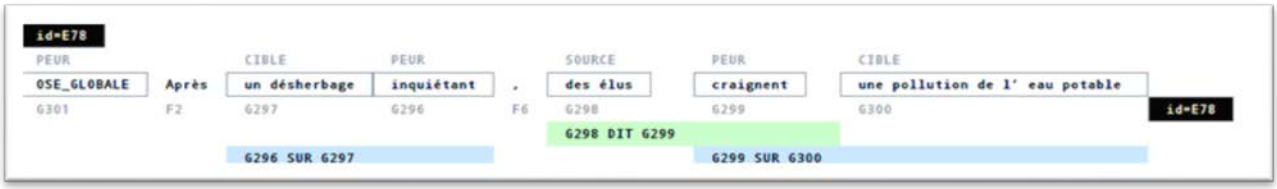
Synopsis of Named Entity annotation linking entity occurences to entity database content.

Annotated Corpora: Defining Representations

Identifying and representing linguistic events are the core tasks behind corpus analysis and annotation. The theme Corpora & Representations precisely aims at elaborating definitions for the linguistic phenomena of interest. These definitions need to easily understood and unambiguous, in order for human annotators to be able to reliably mark the instances of the phenomena they find in the corpora to produce the study material, made of annotated language elements. In particular, this material constitutes essential training/reference material for developing algorithms able to process language data, as it is done for instance in the theme "Information Extraction". The definition of the target linguistic phenomena needs to be specified in a set of annotations guidelines which describe how to solve difficult cases resulting from linguistic variation or the inherent semantic ambiguity pervading all human communication. These guidelines, are in general associated with a reference annotated corpus containing prototypical instances of the targeted phenomena. The production of annotation requires the development of specific software with ergonomic interfaces to browse/manage the corpora and to build the different markup layers over the documents, often deployed in conjunction with fully automatic or semi-supervised pre-annotation softwares to speed up the annotation process. Within the last five years, the domain of corpus annotation is revolutionized by the development of crowdsourcing platforms like Amazon Mechanical Turk or CrowdFlower which drastically diminished the cost of producing annotation, but in their current stage of development these platforms raise questions about the quality of the annotation produced and more serious questions of ethics because of the completely unregulated frame in which they operate. Note that for Sign Language corpora, the material to be annotated is video, as a consequence the amount of data handled are much larger than for text and require image

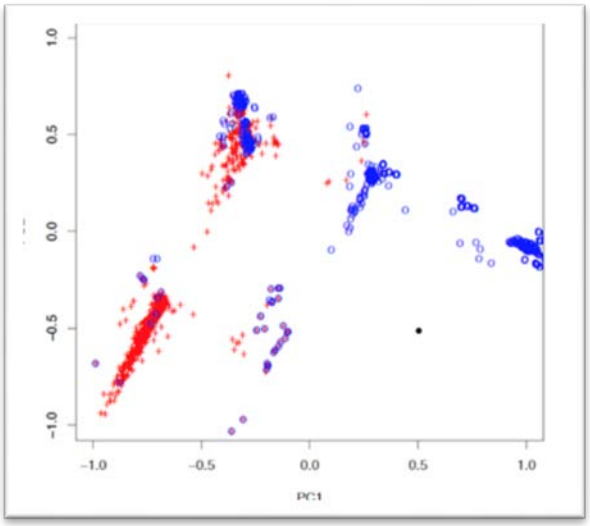
processing, in addition to the fact that models for Sign Language Representation are only beginning to emerge. In 2014, we realized a new type of sign language corpus, using a motion capture system, in collaboration with the CIAMS laboratory of Paris-Sud University. The collected data, covering the whole body and the face, are tridimensional. They will allow us to perform finer analyses than those that can be performed with classic video data.

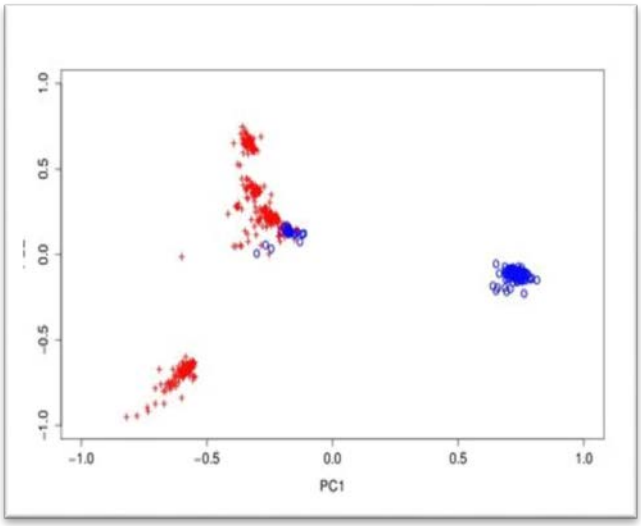
Sample of manual annotation with the Pasta annotation interface and uComp opinions, sentiments and emotions (OSE) model of a microblogging document about climate change. OSE, source (OSE holder) and targets (OSE object) are identified by boxes. The SUR relation links an OSE expression to its target while the DIT relation connects the source to the OSE.



Annotated Corpora for Machine Learning and Evaluation

In the past year, we have organized the 2014 issue of DEFT (Défi Fouille de Textes) for which we have collaborated with the SME "Short Edition" and used their large corpus of very short literary texts (14,000 documents) for the 3 tracks on genre identification and quality assessment. For the other track of DEFT the participant had to identify the session in which the articles of the the open corpus of scientific articles of the national conference TALN (Traitement Automatique du Langage Naturel) had been presented. For the uComp project, we have defined a general annotation scheme for the expression in texts of opinions, sentiments and emotions (Fig A) that is used for annotating a corpus of 15,000 micro blogging messages equally split between French and German. The work implied the crafting of the annotation guidelines, a graphic interface for manual annotation and software for assessing inter-annotator agreement. The uComp corpus will be used in the next year open challenge DEFT. For SONAR we have performed the morpho-syntactic and syntactic analysis of a corpus of 3.522.303 job ads for performing information extraction (e.g. identifying job tasks and required proficiencies) and for studying diachronic evolution of the corpus with machine learning approaches. During last year, we also collaborated with IMMI to complete the collection of a large text corpus of scientific articles (around 145,000 articles) about natural language processing whose analysis is currently underway. In the biomedical domain we have two contributions to report on. The first once is the collaboration with ELDA (Evaluation and Language resources Distribution Agency) to build the "QUAERO médical" corpus, which gathers 3 genres of medical texts annotated with 10 types of normalized entities (Unified Medical Language System Concept Unique Identifiers). This corpus will be used for the 2015 issue of the CLEF-eHealth evaluation campaign. The second contribution is the design and implementation of an annotation model for the "MERLOT" corpus in the context of the "ANR young researcher" project "CABeRneT". Modeling the entities, relations and assertions found in the content of patient medical records required a large effort from our part to define the annotations and produce the annotation guideline and develop the necessary extra functionalities for the BRAT annotation platform.





Love (red crosses) / pleasure (blue circles)

Anger (red crosses) / boredom (blue circles)

PCA 2-dimensional plots of the showing the separability of the lexical classes of the uComp opinions, sentiments and emotions model in the DOXA corpus of video game reviews.

Evaluation Metrics

Building on our proven track record for evaluation organization, we have defined the evaluation measures and implemented evaluation software for the DEFT 2014 challenge on text genre identification and quality assessment for short literature texts and scientific articles. We have also defined the evaluation task and the software metrics for next year challenge DEFT 2015, that will address detecting opinions, sentiments and emotions in microblogging messages with a bilingual corpus (French and German) about climate changes (uComp corpus). For the "CABeRneT" project (see previous paragraph), we have extended the Brateval evaluation software for assessing entities, relations and assertions annotation performances of patient medical records. Last but not least, ILES has also co-organized the evaluation campaigns Tweet Contextualization in 2013 and 2014 (part of the CLEF initiative), that have given rise to the construction of a dedicated corpus and elaboration of new evaluation metrics for tweet contextualization.

Topic 2: Multilingualism

A. Max, T. Hamon, T. Lavergne, A.-L. Ligozat, A. Névéol, P. Zweigenbaum with the participation of D. Bouamor, L. Deléger, C. Grouin, G. Illouz, B. Marie, V. Moriceau, P. Paroubek, X. Tannier, A. Vilnat

By working on language productions with similar meanings but different forms, this research theme provides handles on semantics, the core of human language. At the same time, cross-language portability is a recurring issue in system development. This topic interacts in a transverse way with each of the other three research themes of the ILES group, as well as with the Machine Translation activity of TLP. It has also attracted a Japanese colleague for his sabbatical year in 2012-2013.

Production of multilingual corpora

Corpora are essential elements for training and assessing NLP systems, and collecting and annotating corpora in a multilingual setting is an ongoing activity in the ILES group. In the last period, annotation work has been started in the context of the European uComp project, in collaboration with ELDA, to associate sentiment and opinion information to tweets in French and German.

Adapting Existing NLP Systems to New Languages and Transfer of Information across Languages

Once an NLP system has been developed for a language, it is useful to consider approaches to adapt it to new languages. Furthermore, identifying and extracting interlingual semantic representations, similar to abstract ontological representations of domain concepts, is an essential step towards knowledge representation.

These issues are tackled in ILES, using manual or lightly supervised approaches, the latter now being our main focus of interest. We have started to investigate this topic in the context of the LIMSI-supported project TraLaLa (transfer from language to language), which coordinates work performed along these lines in ILES and TLP; and we have expanded this working group in the context of the Digicosme research group "Représentations Sémantiques Multilingues" (Multilingual Semantic Representations; head: P. Zweigenbaum) together with colleagues from TLP, CEA/LIST, INRA/MIG, LRI/LaHDAK, LTCI/DBWeb, and E3S. This topic was investigated by a jointly supervised MIT PhD student who spent nine months at LIMSI in 2012-2013 under a Châteaubriand fellowship (Bodnari et al., CLEF ER Challenge 2013), or by a collaboration with Univ. Strasbourg on part-of-speech tagging for the low-resourced Alsatian language (Bernhard and Ligozat, 2013). Another line of work has been devoted to tuning the HeidelTime temporal tagger to the biomedical domain in both English and French (Hamon and Grabar, 2014) as well as to the general domain in French (Moriceau and Tannier, 2014).

Acquisition of Monolingual Units and Automatic Paraphrasing

Various natural language expressions may hold similar or related meanings in context, a phenomenon at the heart of natural language semantics which represents a major difficulty for NLP applications. Manually built resources describing all possible paraphrases are a key asset to study these phenomena and to propose new solutions for NLP systems, but they are limited in availability and coverage. The ILES group addresses this issue by developing techniques for the acquisition and use of related monolingual units.

Work has also been initiated on the study of criteria that can motivate text rewriting. A joint study group (ALLuSIF) was set up on the topic on readability measures and text simplification, which involves members from our laboratory and colleagues from Strasbourg University, Marseilles University, and Leuven University (Belgium), producing results in lexical simplification (Ligozat et al., 2013), syntactic simplification (Brouwers et al., 2014) and assessment of text readability (Todirascu et al., 2013). Work on text adaptation has also been started in a project on improving the accessibility of a web platform intended for people with trisomy of chromosome 21 and their family with Trisomie 21 France and Univ. Bordeaux, as well as in the context of acquiring medical term simplified variants and paraphrases (Grabar et al., 2014; Grabar and Hamon, 2014) and to automatically diagnose the complexity of medical words (Grabar et al., 2014). Another line of work is to improve text by learning an appropriate objective function and applying rewriting rules, initially in the context of automatic translation improvement (PhD of B. Marie, in collaboration with the Lingua et Machina company). We have also made an initial attempt at automatically identifying text written by non-native speakers, and have taken part to the first Task on Native Language Identification (Lavergne et al., 2013b).

Acquisition of Bilingual Units and Automatic Rewriting Across Languages

NLP systems need access to resources describing equivalences across languages (bilingual pairs of words, terms, segments, rules, etc.), in order to provide access to information available in foreign languages and to automatically transform some text into an equivalent text in another language.

Work on the construction of specialized bilingual lexicons making use of large-scale background knowledge has been conducted in the context of the PhD of D. Bouamor (Bouamor et al., 2013), and on the identification of difficult-to-understand medical terms in two languages (French and Xhosa) (Grabar et al., 2014). Research on Statistical Machine Translation is also conducted in ILES in

collaboration with the related activity in the TLP group, where work has most notably been conducted on the development of a fully-discriminative translation framework (Lavergne et al., 2013). In the context of an ongoing collaboration with the French Cochrane Centre, medical translation systems for two text registers (medical expert and lay readers) have been developed and are being continuously updated (Névéol et al., 2014), which is included in a larger concern for translation for the biomedical domain (Jimeno Yepes et al., 2013; Jimeno Yepes and Névéol, 2013).

Topic 3: Information Extraction, Focused Information Retrieval, and Question-Answering

B. Grau, R. Beaumont, M. Gleize, C. Grouin, T. Hamon, E. d'Hondt, G. Illouz, L. Lahondes, T. Lavergne, AL. Ligozat, V. Moriceau, A. Névéol, K.H. Nguyen, I. Robba, X. Tannier, C. de Groc, MH. Falco, M. Marchand, V.M. Pho, D. Sadoun, D. Valsamou, W. Wang, L. Deléger, P. Zweigenbaum, with the participation of P. Paroubek, A. Vilnat; A. Bodnari, MFM. Chowdhury

Billions of digital textual documents are now available on-line on the Web and inside organisations. Accessing relevant information in such a wealth of unstructured documents is one of the present challenges of computer science. Therefore a large part of the activity in the ILES group is dedicated to this topic. This includes information extraction (spotting targeted information in texts), focused information retrieval (locating target information in documents to answer a query), and more specifically question-answering (finding precise information in texts to answer natural language questions). These methods complement mainstream information retrieval techniques, whose main goal is document retrieval, by putting more emphasis on a precise analysis of text contents. This activity also provides a test-bed for methods designed in the other ILES research topics, such as representation and paraphrasing. This is a long-running topic in the ILES group, where it has gained visibility by obtaining good positions in international challenges (TREC, CLEF, i2b2).

Text Analysis Methods for Information Extraction

Building a representation from natural language texts is the core part of this research topic, therefore it motivates a large share of our activity. While successful text analysis for information access depends on a complex combination of intertwined methods, we highlight here specific points that we have been addressing.

Contemporary information extraction methods are often based on surface clues; we examine how various levels of syntactic processing help information extraction. At the most basic level, lexico-syntactic extraction patterns, often using semantic classes, are useful abstractions to detect entities (including discontinuous entities) and relations. Tense and aspect are obviously important clues for temporal expression analysis and normalization (Kessler et al., 2013, Nguyen et al., 2014). In question-answering, syntactic analysis builds a more structured representation of questions or passages and helps match answers to questions more precisely. Dedicated analysis of HTML documents allows to extract answers in tables and enumerative structures for questions expecting multiple correct answers (Falco, PhD 2014).

Relevant information is often spread across multiple sentences or even across multiple documents. We address multi-sentence processing through co-reference resolution (Lavergne et al., BMC Bioinfo 2015). This line of work sparkled a collaboration with FBK (Trento), who sent an FBK PhD student for a three-month stay at LIMSI in spring 2012 to design a machine-learning-based co-reference system (Chowdhury & Zweigenbaum, 2013). At another level, we work on temporal analysis and reasoning to build timelines by following up events in and across news stories (Kessler et al., 2013, Nguyen et al., 2014) or in patient notes (Grouin et al., JAMIA 2013 ; Grouin et al., i2b2 2014 ; Hamon et al., CLEF eHealth 2014).

In this reporting period we have increased our use and knowledge of supervised machine learning (ML) methods. Given our initial expertise, our role in this context has been to model the input material (texts, sentences, phrases, words) with suitable features rather than to develop new ML

algorithms. This part of the work is generally given low priority in ML venues, but is indeed of utmost importance in a domain where input data displays complex structure and properties. For the present time, feature engineering is more an art than a science, and we are incrementally building up know-how that we hope to convert into principles as we become more knowledgeable. Given the rarity and sparsity of annotated corpora for machine learning, we are also trying to understand better how to optimize expert input to prepare annotated training corpora (Grouin et al., LAW 2014).

We also enriched our machine-learning approaches using unsupervised algorithms, such as unsupervised clustering based on Brown's algorithm. The result of such clustering is then used as features to train CRF models for information extraction tasks (Chatzimina et al., LREC 2014), as well as during our participation in several NLP challenges: BioNLP-ST (Grouin, BioNLP 2013) and i2b2/UTHealth (Grouin et al., i2b2 2014).

Levels of Information Extraction

Information extraction aims at spotting different types of target elements in texts. We list below those we address.

- The identification of document zones is sometimes necessary to characterize content-rich document sections. This allowed to target medical content for document analysis (Deléger and Névéol, 2014).
- Named Entities (names of persons, locations, organisations, etc.) and terms are the basic information units that generally need to be extracted. On the one hand we have extended these general entity types (see Corpora and Representations). On the other hand we have addressed various entity types relevant to specialized texts, including biological texts and patents, medical texts (Bodnari et al., 2013; Grouin et al., 2014, Hamon & al., 2014), including those necessary to anonymise clinical texts (Grouin & Névéol, 2014). When dealing with specialized texts, methods based on distributionality suffer from data sparsity. We studied this problem by adding relations acquired from corpora (Perinet et al. 2014).
- Assertions and relations between entities provide a rich document representation and make for informative features in document classification (Pham et al. 2014).
- Event descriptions are important building blocks for higher-level text representation or for populating knowledge bases (leading to a co-supervised PhD with TLP group). In open-domain information extraction, events are less studied than general named entities such as the names of persons and locations. We focus our work on nominal forms of events. After having designed methods to build lexicons of event names and automatically extract names of events in texts we have addressed the detection of noun-based events in clinical texts (Grouin et al., 2013). Project ASTRE focuses on open event extraction to define event templates and structures automatically. In the scientific literature, we worked on extracting the data related to a type of biological event: experiment results guided by an ontology (Minard et al., 2013). We also studied domain-centered word representations for labeling roles in event extraction (Boros et al., 2014).
- Temporal information further provides a higher-level structure to a document or document collection. Our aim in the Chronolines project is to build thematic timelines for a general domain topic defined by a user query. We focused our research primarily on extracted temporal information as opposed to other textual content and showed that using linguistic temporal processing together with classical machine learning techniques helps extract important events in texts (Kessler et al., 2013).
- Opinions and sentiments contribute another dimension of the information conveyed by texts. In opinion mining, the two main trends nowadays are machine-learning- and lexicon-based approaches. For the latter, the availability, extent and quality of the opinion/sentiment lexicon are essential (Morgan et al. 2014).

Beyond surface representations

Information extraction, focused search and question answering often rely on bags of words or terms or entities to find relevant information. We have pointed out earlier that more advanced clues can be useful for information extraction. To go further in some tasks, a symbolic, ontology-based representation is necessary. To recognize and represent user requirements given in natural language, an ontology of the target domain guides information extraction and allows for reasoning (Sadoun et al., 2013).

Semantic reasoning generally involves different kinds of knowledge that have to be combined, and different kinds of inferences to perform. We studied such problems in the framework of multiple-choice question resolution (Grau et al., 2013 ; Gleize et al., 2014) and generation (Pho et al., 2013), or to evaluate student answers to open questions given the teacher's reference, by reducing the difficulty of the vocabulary (Gleize and Grau, 2013).

As knowledge is more and more disseminated in knowledge base available on the Web, querying Linked Data is becoming crucial and Natural Language interfaces are recognized as suitable for this task. We proposed a rule-based approach to translate natural language questions into SPARQL queries and applied the method for querying three biomedical knowledge bases (Hamon et al. 2014). This type of method is also applicable to query document collections from which information has been extracted and represented as RDF triples (Ben Abacha & Zweigenbaum, 2014), thus paving the way to unified access to both structured and unstructured data.

At the document level, topics in a text collection may be represented as graphs of weighted terms which represent a domain or a document. Graphs of terms and documents also help design algorithms to build a specialized corpus. These graphs support Pagerank-style algorithms to weight terms and/or documents, and can be used in a vertical search engine to build the search collection and to perform query expansion (de Groc, PhD 2013).

Connection to other ILES themes

Most of the work described in this section applies to French or English, often with a multilingual dimension, e.g. designing methods on one language and transferring them to another, or designing cross-language search methods. Please see section Multilingualism and Paraphrasing on this topic. A large part of this work has been evaluated through our participation in national and international challenges. In many instances, we also designed internal development or test corpora, or collaborated to or coordinated the design of the challenges. Please see section Corpora and Representations on this topic.

Topic 4: Sign Language Modelling and Processing

***A. Braffort**, L. Bolot, A. Choisier, M. Filhol, C. Verrecchia, M. Benchiheub, M. Hadjadj*

Sign languages (SLs) are natural languages used by the deaf. These languages are expressed in space by means of a set of articulators (chest, shoulders, arms, hands, head, facial expressions, gaze directions, etc.), that are carried out simultaneously, providing a multilinear spatio-temporal signal. SLs have no writing system and the only form of writing available to the deaf is generally that of the spoken language (SpL) of the country they live. But the majority of the profoundly deaf has limited skills in writing and reading, hence has limited access to written information. This need has generated an interest among researchers in Sign Language recognition, generation and machine translation.

- The theme Sign Language Modelling and Processing concerns the study of sign languages, according to four complementary aspects: corpus, modelling, generation, and translation.

Sign Language Corpora

SLs are less-resourced languages, with few reference books (grammars, dictionaries) and only few small-scale corpora. We participate in the creation of LSF corpora, and develop methodologies for elicitation, annotation (qualitative and quantitative), and analysis.

During the 2013-2014 period, we have worked on two corpora:

- Constitution of a LSF lexicon in 3D (lexical signs of LSF in the form of 3D animations for a virtual signeur) in collaboration with Visuel-LSF.
- Constitution of a LSF corpus acquired with a motion capture system, in collaboration with CIAMS lab. It has been created to serve pluridisciplinary studies, including movement sciences, linguistics and computing sciences. This works is supported by the Paris-Sud University (M. Benchiheub PhD funding), and the CNRS (APLUS project, funded by the PEPS HuMaIn).

Sign Language Modelling

The goal of Sign Language modelling is to build formal representations and tools that represent how the SL operates and that will be usable in analysis, recognition or generation software. Formal approaches to representing the signs or the utterance of SL are generally based on models or approaches that have been developed for spoken language or even written language processing, with strong limitations and drawbacks. Thus we work on designing new models, based on corpus observation and analysis.

Recently, we have designed the AZee model. AZee is a model to describe and synchronise articulatory forms, built with the philosophy above to synthesise signed productions with a virtual signer, or signing avatar.

According to the studies led in the team, we feed a database with AZee descriptions, the hypothesis being that the set of descriptions forms a complete grammar. AZee is still under construction and evaluation. Current work consists to look at structures and linguistic rules related to temporal aspects and locations in short LSF videos related to news (Mohamed Hadjadj PhD).

Sign Language Generation

The assessment of quality of representations goes through their implementation in software platforms, in our case that is automatic generation. Automatic generation of SL utterances is visualized by the animation of a virtual signer (virtual character in 3 dimensions).

During the 2013-2014 period, we begun the design of KAZOO, a web application for sign language (SL) generation using a virtual signer. KAZOO uses our linguistic model AZee and partly reuses Octopus and GeneALS applications developed some years ago, with some adaptations. AZee and GeneALS have been put together to provide an animation from an AZee description. Parts of Octopus have been used for computation and final display of the 3d animation.

This is an on-going project, but the current version offers the possibility to animate a virtual signer automatically and synthesize the contents using an abstract representation, our linguistic model AZee, providing a means of validating this model.

Sign Language Translation

The historic centerpiece of NLP is automatic translation. Considering the crucial part it can play in terms of accessibility for deaf people, it only appeared legitimate to us that we start investigating the path to text-to-Sign translation.

We start with AZee descriptions of SL production rules, and use each one as the starting point of an extraction task in the source text. Detected patterns or extracted chunks of text therefore make the corresponding SL rule a candidate for translation.

Annotation and study of SL time expressions are now being carried out on our Parallel corpus, while we are moving on with the text extraction of a few already known rules such as enumeration.

Highlights

- Beyond the design of methods to solve natural language processing problems, ILES has produced and made available a number of annotation models, guidelines, annotated corpora: first motion capture corpus of French Sign Language (LSF) for pluridisciplinary studies, KAZOO, a web application for sign language generation using a virtual signer, guidelines for annotation of opinion and sentiment, of medical entities and relations, and associated annotated corpora. ILES also designed evaluation metrics and organized shared tasks to evaluate natural language processing systems based on these corpora. ILES members themselves participated in a number of international shared tasks placing in the top ten in most cases.
- ILES members have chaired or organized international and national conferences and workshops and hold new leading positions in international and national associations: Chair of the International Medical Informatics Association (IMIA) Francophone SIG, President of the Association pour le traitement automatique des langues (ATALA), Vice-President of the Association française pour l'intelligence artificielle (AFIA). Pierre Zweigenbaum was elected Fellow of the American College of Medical Informatics. ILES members have responsibilities in a book series, six journals, two journal special issues, and lead the NLP section of the Yearbook of Medical Informatics.
- ILES has a sustained level of collaboration with companies through FUI projects, CIFRE PhD theses, technology transfer, and consulting. Repeated efforts to submit high-quality project proposals have succeeded in obtaining new project grants in the present period, including three ANR grants among which one Young Researcher award led by ILES (JCJC Cabernet, BLANC Vera, Restaure), three FUI projects (Sonar, Request, Patient Genesys), one ANSM (Vigi4MED), one Partenariat Hubert Curien with Belgium, and one Digiteo award (Astre).
- ILES is highly involved in training researchers at the Masters and Doctorate levels, as well in the new ICT Doctoral School of Paris Saclay University, than in Masters degrees (U PSud, INALCO). The group is also highly involved in PhD student mentorship : twenty PhD students were present in the period, among whom four defended.

Staff

Permanent staff

Last name	First name	Position	Employer	HDR	Arrived	Left
Bolot	Laurence	IE1C	CNRS			
Braffort	Annelies	DR2	CNRS	HDR		
Choisier	Annick	IE2	CNRS			
Filhol	Michael	CR2	CNRS			
Grau	Brigitte	Pr1	ENSIIE	HDR		
Grouin	Cyril	IE2	CNRS			
Hamon	Thierry	MC	Université Paris-Nord		01/11/2013	
Illouz	Gabriel	MC	Université Paris-Sud			
Lavergne	Thomas	MC	Université Paris-Sud			
Ligozat	Anne-Laure	MC	ENSIIE			
Max	Aurélien	MC	Université Paris-Sud			
Moriceau	Véronique	MC	Université Paris-Sud			
Névéol	Aurélie	CR1	CNRS			
Paroubek	Patrick	IR1	CNRS	HDR		
Robba	Isabelle	MCHC	Université Versailles St Quentin			
Tannier	Xavier	MC	Université Paris-Sud	HDR		
Verrecchia	Cyril	AI	CNRS			
Vilnat	Anne	Pr1	Université Paris-Sud	HDR		
Zweigenbaum	Pierre	DR2	CNRS	HDR		

PhD Students

Last name	First name	Arrived	Thesis defense	Ecole Doctorale	School / University
Asadullah	Munshi	01/10/2012		EDIPS	Université Paris-Sud
Beaumont	Romain	01/10/2014		EDIPS	Université Paris-Sud
Benchiheub	Mohamed-el-Fatah	13/11/2013		EDSP Paris-Sud	Université Paris-Sud
Bodnari	Andrea	03/09/2012		EDIPS	Université Paris-Sud & MIT
Boros	Emanuela	04/02/2013		EDIPS	Université Paris-Sud
Bouamor	Dhouha	28/10/2010	21/02/2014	EDIPS	Université Paris-Sud
De Groc	Clément	18/11/2009	05/06/2013	EDIPS	Université Paris-Sud
Falco	Mathieu-Henri	01/10/2010	22/05/2014	EDIPS	Université Paris-Sud
Gawich	Mariam	01/12/2014		EDIPS	Université Paris-Sud & University Ain Shams (Le Caire)
Gleize	Martin	01/10/2012		EDIPS	Université Paris-Sud
Hadjadj	Mohamed	01/11/2013		EDIPS	Université Paris-Sud
Lahondes	Loïc	01/11/2013		EDIPS	Université Paris-Sud
Marchand	Morgane	05/12/2011		EDIPS	Université Paris-Sud
Marie	Benjamin	02/04/2013		EDIPS	Université Paris-Sud
Pho	Van-Minh	01/10/2012		EDIPS	Université Paris-Sud
Sadoun	Driss	01/10/2010	17/06/2014	EDIPS	Université Paris-Sud
Valsamou	Dialekti	25/10/2012		EDIPS	Université Paris-Sud

Non permanent staff

Last name	First name	Position	Employer	Arrived	Left
Bouamor	Dhouha	CDD Post-Doc	CNRS	01/12/2014	30/11/2015
Cohen	Kevin	Professeur invité	University of Colorado	01/06/2014	15/07/2014
Cohen	Kevin	Professeur invité	University of Colorado	01/12/2014	24/12/2014
D'Hondt	Eva	CDD IE	CNRS	01/04/2014	30/06/2014
D'Hondt	Eva	PostDoc	CNRS	01/07/2014	30/06/2015
Delaborde	Marine	CDD IE	CNRS	01/05/2014	31/12/2015
Deléger	Louise	Chercheur	CNRS	01/12/2012	31/08/2013
Deléger	Louise	Chercheur	CNRS	01/12/2013	31/08/2014
Falco	Mathieu-Henri	ATER	Université Paris-Sud	01/10/2013	31/08/2014
Fraisse	Amel	Chercheur	CNRS	01/02/2013	31/10/2013
Fraisse	Amel	Chercheur	CNRS	01/11/2013	31/07/2014
Fraisse	Amel	Chercheur	CNRS	01/08/2014	31/05/2015
Morlane-Hondère	François	PostDoc	CNRS	01/11/2014	31/10/2015
Nagata	Ryo	Invité	Konan University	01/09/2012	31/08/2014
Nguyen	Kiem-Hieu	Chercheur	CNRS	01/03/2013	31/12/2013
Nguyen	Kiem-Hieu	Chercheur	CNRS	01/01/2014	30/06/2015
Nouvel	Damien	CDD	CNRS	01/08/2013	31/07/2014
Sadoun	Driss	ATER	Université Paris-Sud	01/10/2013	31/08/2014

Internships

Last name	First name	Arrived	Left	Prepared degree	School / University
André	Thibault	24/06/2013	16/08/2013	Master linguistique	Université Catholique de Louvain
Audebert	Bernard	23/06/2014	29/08/2014	DUT Informatique	Université Paris-Sud
Beaumont	Romain	10/03/2014	10/09/2014	M2	Université Paris-Sud
Chatzimina	Maria	02/04/2013	15/09/2013	Master Franco-Héllénique	Université Paris-Sud
Delaborde	Marine	01/03/2013	31/07/2013	Master	Université Sorbonne Nouvelle
Demanou	Jeff	13/06/2014	29/08/2014	Ingénieur	Polytech Paris-Sud
Giannetti	Frédéric	08/04/2013	30/09/2013	M2 DEFI Linguistique	Université Paris Ouest Nanterre
Gianola	Lucie	01/05/2014	30/09/2014	Master Professionnel informatique	INALCO
Hadjadj	Mohamed	01/04/2013	31/08/2013	Master 1 Informatique	Université Grenoble 3
Lahondes	Loïc	02/04/2013	27/09/2013	Master	ENSIIE Evry
Matveeva	Yulia	26/05/2014	27/06/2014	M1 Linguistique	Université Paris Diderot
Megahed	Dalia	14/04/2014	17/10/2014	M2Pro	INALCO
Mizumoto	Tomoya	23/04/2013	18/07/2013	Doctorat	Nara Institute of science Japon
Rabary	Christelle	01/07/2014	29/08/2014	Licence	Université Paris Diderot
Rubiano	Thomas	01/04/2014	30/09/2014	Master Informatique	Université Paris Nord
Sidahmed	Mana	21/01/2013	31/05/2013	M1	Université Paris-Sud

Indicators of scientific notoriety

Prizes and awards

- P. Zweigenbaum, Fellow of the American Medical Informatics Association, 2014
- T. Hamon, Scientific excellence award (Oct. 2013-Sep. 2017)
- C. Grouin, P. Zweigenbaum, AMIA 2014 Distinguished Papers Reviewers, 2014

Scientific events

- C. Grouin, P. Paroubek, P. Zweigenbaum, chairs of workshop DEFT at TALN, Les Sables-d'Olonne, France 2013
- C. Grouin, T. Hamon, P. Paroubek, P. Zweigenbaum, chairs of Workshop DEFT at TALN, Marseille, France, 2014
- T. Hamon, co-chair of the 4th International Workshop on Computational Terminology (Computerm 2014), Dublin, Ireland, 2014
- V. Moriceau, X. Tannier, co-organisers of Tweet Contextualization@CLEF, Sheffield, 2014
- V. Moriceau, X. Tannier, co-organisers of Tweet Contextualization@CLEF, Valencia, 2013
- P. Zweigenbaum, chair of ACL workshop BioNLP-ST, Sofia, Bulgaria, 2013
- P. Zweigenbaum, co-chair of ACL workshop on Building and Using Comparable Corpora, Sofia, Bulgaria, 2013
- P. Zweigenbaum, chair of the workshop of the Francophone SIG of IMIA at MEDINFO 2013
- P. Zweigenbaum, chair of LREC workshop on Building and Using Comparable Corpora, Reykjavik, Iceland, 2014
- P. Zweigenbaum, chair of Journées francophones d'informatique médicale (JFIM 2014), Fès, Morocco, 2014

Editorial activities

Reviewing for international journals:

Advances in Medical Education and Practice, ACM Transactions on Accessible Computing, ACM Transactions on Intelligent Systems and Technology, ACM Transactions on Management Information Systems, Artificial Intelligence in Medicine, BMC Bioinformatics, Corpora, Dialogue & Discourse, IMIA Yearbook, Information Retrieval, Journal of Biomedical Informatics, Journal of Medical Internet Research, PLOS-ONE, Terminology, Universal Access in the Information Society

Reviewing for national journals: Discours, Revue d'intelligence artificielle, Traitement automatique des langues

Reviewing for international conferences: ACL 2013, 2014, COLING 2014, SIGIR 2014 (Poster), EMNLP, LREC 2014, AIME 2013, AMIA 2013, 2014, TIA 2013, LBM 2013, ICHI 2013, JSSP 2013, SMBM 2014, JADT 2014…

Reviewing for national conferences: TALN 2013, 2014, CORIA 2013, 2014, IC 2014,...

- B. Grau, RSTI-Document numérique, editorial board member
- B. Grau, RSTI-Technique et Science Informatiques, editorial board member
- A. Névéol, Traitement automatique des langues, editorial board secretary
- P. Paroubek, Hermes-Lavoisier's Language and technology series, series editor
- P. Paroubek, Traitement automatique des langues, editorial board member
- P. Zweigenbaum, Traitement automatique des langues, editorial board member (-2013)
- P. Zweigenbaum, Cahiers du CENTAL book series, editorial board member
- P. Zweigenbaum, Terminology, editorial board member
- P. Zweigenbaum, RSTI-Revue d'intelligence artificielle, editorial board member
- P. Zweigenbaum, Information - Interaction – Intelligence, editorial board member

- P. Zweigenbaum, BMC Bioinformatics, special issue co-editor, 2014
- P. Zweigenbaum, Journal of Natural Language Engineering, special issue co-editor, 2015

Invited lectures, talks or seminars

- B. Grau, Evaluation et systèmes complexes de recherche d'information, Ecole d'automne en Recherche d'Information (EARIA), Grenoble, Octobre 15-17 2014
- C. Grouin, Automatic De-Identification of French Clinical Texts. ICU datamining workshop, Paris, France. July 9, 2013.
- C. Grouin, Protocole et expériences d'anonymisation des données personnelles contenues dans les comptes-rendus hospitaliers. Séminaire "Anonymisation de corpus". MSH Lorraine. Nancy, France. April 4, 2014.
- C. Grouin, P. Zweigenbaum, Le traitement automatique des langues (TAL) et les statistiques : panorama et problématiques. Journée d'étude de la SFdS, Paris, France. April 11, 2013.
- T. Hamon, Natural Language Processing Approaches and Applications. 4 ERASMUS Lectures at the Mälardalen University, Västerås, Sweden. March 5-14, 2014.
- V. Moriceau, Extraction d'information et analyse temporelle de textes, IRIT, May 19, 2014.
- A. Névéol, Natural Language Processing for extracting knowledge from free-text, National Library of Medicine (Bethesda, MD). November 21, 2013.
- A. Névéol, Traitement Automatique de la Langue pour l'extraction d'information des dossiers électroniques patient. Inserm, équipe 22 (Paris), 2013.
- A. Névéol, Traitement Automatique de la Langue pour la Santé Publique. ISPED laboratory, Bordeaux, France. July 7, 2014
- X. Tannier, Finding Salient Dates for Building Thematic Timelines, Franco-Egyptian Workshop, Cairo, Egypt, 2013
- X. Tannier, Évenement : représentation et extraction, Laboratoire de Recherche en Informatique, Orsay, France, 2013
- P. Zweigenbaum, Medical language processing, specialised language of medical domain, and aspects of multilingualism, 4th International Louhi Workshop on Health Document Text Mining and Information Analysis, Sydney, NSW, Australia, 2013
- P. Zweigenbaum, Semantic types and semantic grammars for clinical texts, Workshop on Computational Semantics in Clinical Texts (CSCT) at the 10th International Conference on Computational Semantics (IWCS), Potsdam, Germany, 2013
- P. Zweigenbaum, LIMSI Research in Human Language Technology, Franco-Egyptian Workshop, Cairo, Egypt, 2014
- P. Zweigenbaum, Extraction d'informations à partir de textes dans le dossier patient, ISPED laboratory, Bordeaux, France, 2014

Participation in expertise and administration of research (y compris expertise de projets)

- T. Hamon, project expertise, NCSTE, Kazakhstan, 2014
- A. Névéol, project expertise, CRITT santé Bretagne, 2014
- A. Vilnat, pre-project expertise, of ANR 2013 and 2014.
- A. Vilnat, member of DIGITEO program committee.
- P. Zweigenbaum, member of ANR TecSan 2013 evaluation committee
- P. Zweigenbaum, project expertise, ERC Consolidator, Je-S (UK), SNF (CH), L&C (CH), PRST MISN, ECOS Nord (FR-Hispanic America), ANR
- P. Zweigenbaum, promotion expertise, tenure track (Columbia U.), PES

Ph.D and Habilitation committees

- A. Braffort, 3 PhD (rapportrice)
- B. Grau, 7 PhD (2 rapporteur, 3 examinateur, 2 directeur), 1 HDR (examinateur)

- V. Moriceau, 1 PhD (co-directeur)
- A. Névéol, 1 PhD (co-directeur)
- X. Tannier, 1 PhD (co-directeur)
- A. Vilnat, 12 PhD (10 présidente, 1 rapporteur, 1 co-directeur), 4 HDR (4 Présidente)
- P. Zweigenbaum, 19 PhD (3 président, 10 rapporteur, 1 "opposant", 5 directeur; among which 7 out of France), 3 HDR (1 président, 1 rapporteur, 1 "parrain")

Position in Scientific Councils or Associations or Networks

- B. Grau, Orientation committee of ARIA, Association Francophone de Recherche d'Information et Applications
- C. Grouin, Board Member of French Association for Natural Language Processing (ATALA), 2011-
- T. Hamon, Board Member of French Association for Natural Language Processing (ATALA), 2012-
- T. Hamon, Moderator of the mailling list LN (ATALA), 2000-
- P. Paroubek President of French Association for Natural Language Processing (ATALA), 2013-
- A. Vilnat, Board Member of French Association for Natural Language Processing (ATALA),
- P. Zweigenbaum, founding chair of Francophone Special Interest Group, International Association for Medical Informatics （IMIA), 2012-2015
- P. Zweigenbaum, member of Standing committee of the national TALN conference, ATALA, 2013, 2014
- P. Zweigenbaum, Vice-President of the French Association for Artificial Intelligence (AFIA), 2014
- P. Zweigenbaum, Board Member of Association for Medical Informatics (AIM), 2011-; in charge of international affairs, 2013-
- P. Zweigenbaum, Scientific Council of the GREYC Laboratory, Caen

Dissemination and scientific outreach

- A. Max, Fête de la science, Orsay, 2013, 2014

Research conventions and contracts

Starting date	Ending date	Acronym	Category	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/09/13	30/10/17	CABeRneT	Collaboration de recherche	ANR	Névéol Aurélie	Névéol Aurélie	National	217 166	JCJC
01/09/12	31/08/15	ACCORDYS	Collaboration de recherche	ANR	Charlet Jean	Zweigenbaum Pierre	National	206 072	CONTINT
01/02/11	31/01/14	ChronoLines	Collaboration de recherche	ANR	Battistelli Delphine	Tannier Xavier	National	112 074	CONTINT
01/10/12	31/07/16	TransRead	Collaboration de recherche	ANR	Yvon François	Yvon François	National	236 222	CONTINT
01/10/14	31/03/19	RESTAURE	Collaboration de recherche	ANR	Delphine Bernhard	Ligozat Anne-Laure	National	78 245	non thématique
01/01/13	31/12/15	VERA	Collaboration de recherche	ANR	Estève Yannick	Rosset Sophie	National	75 810	non thématique
01/01/14	30/06/17	JOKER	Collaboration de recherche	ANR	Devillers Laurence	Devillers Laurence	National	266 369	Chist-ERA
15/11/12	14/11/15	uComp	Collaboration de recherche	ANR	Wilhelmus Peters	Paroubek Patrick	National	183 997	CHIST-ERA
31/12/13	30/06/16	VIGI4MED	Collaboration de recherche	ANSM	Bousquet Cédric	Zweigenbaum Pierre	National	109 140	
22/10/13	21/02/16	Patient GeneSys	Collaboration de recherche	BPI	Leleu Jérôme	Zweigenbaum Pierre	National	115 756	Pôle de compétitivité

Starting date	Ending date	Acronym	Category	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/02/14	31/01/17	REQUEST	Collaboration de recherche	BPI	Gouttas Catherine	Paroubek Patrick	National	265 492	Investissement d'avenir
18/03/13	31/12/16	SONAR	Collaboration de recherche	BPI	Gariel Jean-Baptiste	Paroubek Patrick	National	212 600	Pôle de compétitivité
01/04/08	31/12/13	QUAERO	Collaboration de recherche	OSEO	Gauvain Jean-Luc	Gauvain Jean-Luc	Européen	7 506 519	
03/09/12	02/09/15	ProjEstimate	Collaboration de recherche	Région Ile de France	Hamon Patrick	Paroubek Patrick	National	303 010	Pôle de compétitivité
20/11/13	19/11/19		Autre	Région Ile de France	Braffort Annelies	Braffort Annelies	National	102 200	Financement de thèse
01/10/12	30/09/15	ANETH	Collaboration de recherche	Digiteo	Ligozat Anne-Laure	Ligozat Anne-Laure	National	102 200	Autre
01/01/14	30/06/15	ASTRE	Collaboration de recherche	Digiteo	Tannier Xavier	Tannier Xavier	National	76 200	
01/01/14	31/12/14	APLUS	Collaboration de recherche	CNRS	Braffort Annelies	Braffort Annelies	National	5 000	PEPS
01/04/13	31/03/16		Collaboration de recherche	Lingua & Machina	Max Aurélien	Max Aurélien	Industriel	13 500	CIFRE
20/02/14	31/12/15	GT Représentations sémantiques multilingues	Labex	Labex Digicosme	Zweigenbaum Pierre	Zweigenbaum Pierre	National	2 600	Groupe de travail
25/02/14	24/02/15		Contrat équipe-conseil	SPIDEO	Grau Brigitte	Grau Brigitte	Industriel	7 425	
01/05/13	30/04/14	QA4MRE 2013	Mise à disposition	CELCT	Grau Brigitte	Grau Brigitte	International	-	
16/07/14	31/12/15	THYME	Mise à disposition	Mayo Clinic	Zweigenbaum Pierre	Zweigenbaum Pierre	International	-	
20/10/14	19/10/20	LERUDI	Mise à disposition	CHU Rouen	Névéol Aurélie	Névéol Aurélie	National	-	
10/12/07	10/12/99	logiciel Syntex	Mise à disposition	Université de Toulouse Le Mirail	Vilnat Anne	Vilnat Anne	National	-	
18/03/14	31/12/15	CLEF e Health 2014	Mise à disposition	ELDA	Hamon Thierry	Hamon Thierry	Associatif	-	
06/12/11	06/12/99	DEFT'08	Mise à disposition	ELDA	Grouin Cyril	Grouin Cyril	Associatif	-	
2014		I2b2 2014	Mise à disposition	i2b2	Grouin Cyril	Grouin Cyril		-	
20/02/14	19/02/17		Collaboration de recherche	ARDM	Yvon François	Yvon François	Associatif	-	CIFRE
13/10/09	12/10/20	DOXA-NDA	Accord de secret	EDF	Paroubek Patrick	Paroubek Patrick	Industriel	-	
29/07/13	28/01/15		Accord de secret	SPIDEO	Grau Brigitte	Grau Brigitte	Industriel	-	

Valorization

Patents, software, licence agreements…

licence agreement	Starting date	Ending date	Licensee	Responsible for LIMSI	Comment
Medina	30/01/13	29/01/14	Centre Hospitalier Bar le Duc	Grouin Cyril	
Medina	30/01/13	29/01/14	HEGP	Grouin Cyril	

Wapiti	since 2009	Logiciel libre utilisé par les organismes publics de recherche		Lavergne Thomas	Licence BSD
WebAnnotator	since 2011	Logiciel libre utilisé par les organismes publics de recherche		Tannier Xavier	Licence CeCILL
DCTFinder	since 2013	Logiciel libre utilisé par les organismes publics de recherche		Tannier Xavier	Licence CeCILL
Heideltime	since 2014	Logiciel libre utilisé par les organismes publics de recherche		Moriceau Véronique	Licence GNU GPL
OCTOPUS : virtual signer animation software for French Sign Language synthesis from a concatenation of predefined animations	01/12/2009	30/11/2019	Websourd	Bolot Laurence	

Scientific publications

Doctoral theses and HdR

1. De Groc, C., *Collecte orientée sur le Web pour la recherche d'information spécialisée* 2013, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 5 juin 2013, 154p p.
2. Falco, M.-H., *Répondre à des questions à réponses multiples sur le Web* 2014, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 22/05/14.
3. Grouin, C., *Anonymisation de documents cliniques : performances et limites des méthodes symboliques et par apprentissage statistique* 2013, thèse de LIMSI-CNRS, INSERM U872 Eq20, UPMC. Soutenue à Orsay, France, le 26 juin 2013, 258 p.
4. Paroubek, P., *De l'évaluation en Traitement Automatique des Langues*, 2013, HdR École Doctorale d'Informatique de l'Université Paris-Sud, soutenue à Orsay, France, le 19/04/2013. 94 p.
5. Sadoun, D., *Des spécifications en langage naturel aux spécifications formelles via une ontologie comme modèle pivot* 2014, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 17 Juin 2014, 234 p.
6. Tannier, X., *Traitement des événements et ciblage d'information*, 2014, HdR Université Paris-Sud, soutenue à Orsay, France, le 18/06/2014. 118 p.

Articles in peer reviewed scientific journals

1. Bellot, P., A. Doucet, S. Geva, S. Gurajada, J. Kamps, G. Kazai, M. Koolen, A. Mishra, V. Moriceau, J. Mothe, M. Preminger, E. SanJuan, R. Schenkel, X. Tannier, M. Theobald, M. Trappett, A. Trotman, M. Sanderson, F. Scholer, and Q. Wang, *Report on INEX 2013.* SIGIR Forum, 2013. **47** (2): pp.1-12.
2. Bellot, P. and B. Grau, *Recherche d'information et fouille de textes.* L'information grammaticale, 2014. (141): pp.37-43.
3. Ben Abacha, A. and P. Zweigenbaum, *MEANS : une approche sémantique pour la recherche de réponses aux questions médicales.* TAL (Traitement Automatique des Langues), 2014. **55** (1): pp.71-104.
4. Bouamor, H., A. Max, and A. Vilnat, *Multi-technique paraphrase alignment: A contribution to pinpointing sub-sentential paraphrases.* ACM Transactions on Intelligent Systems and Technology, 2013. **4** (3): pp.39_1-39_26.
5. Boula De Mareüil, P., G. Adda, M. Adda-Decker, C. Barras, B. Habert, and P. Paroubek, *Une étude quantitative des marqueurs discursifs, disfluences et chevauchements de parole dans des interviews politiques.* TIPA. Travaux interdisciplinaires sur la parole et le langage, 2013. **29**: pp.18.
6. Chowdhury, F. and P. Zweigenbaum, *A controlled greedy supervised approach for co-reference resolution on clinical text.* Journal of Biomedical Informatics, 2013. **46** (3): pp.506-515.
7. Dupuch, M., L. Dupuch, T. Hamon, and N. Grabar, *Exploitation of semantic methods to cluster pharmacovigilance terms.* Journal of Biomedical Semantics, 2014. **5** (1): pp.18-31.
8. Grabar, N., T. Hamon, and D. Amiot, *Interprétabilité et lexique spécialisé.* Verbum, 2014.
9. Grouin, C., N. Grabar, T. Hamon, X. Tannier, and P. Zweigenbaum, *Eventual situations for timeline extraction from clinical reports.* Journal of the American Medical Informatics Association - A scholarly journal of informatics in health and biomedicine, 2013. pp.27p.
10. Grouin, C. and A. Névéol, *De-identification of clinical notes in French: Towards a protocol for reference corpus development.* Journal of Biomedical Informatics, 2014. pp.1-10.
11. Jimeno Yepes, A., E. Prieur-Gaston, and A. Névéol, *Combining MEDLINE and publisher data to create parallel corpora for the automatic translation of biomedical text.* BMC Bioinformatics, 2013. **14**: pp.146-146.
12. Minard, A.-L., B. Grau, A.-L. Ligozat, and S.R. Thomas, *Extraction de relations complexes, Application à des résultats expérimentaux en physiologie rénale.* Technique et Science Informatiques, 2013. **32** (1): pp.75-108.

13. Paroubek, P., A. Pak, A. Fraisse, and G. Francopoulo, *Normalization of term weighting scheme for sentiment analysis.* Lecture Notes in Computer Science/Lecture Notes in Artificial Intelligence (LNCS/LNAI) series., 2013. **8387**: pp.116-128.
14. Pham, D., A. Névéol, T. Lavergne, Yasunaga, Clément, J. Meyer, Morello, and A. Burgun, *Natural language processing of radiology reports for the detection of thromboembolic diseases and clinically relevant incidental findings.* BMC Bioinformatics, 2014. **15** (266): pp.10.
15. Wang, W., R. Besançon, O. Ferret, and B. Grau, *Extraction et Regroupement de Relations entre Entités pour l'Extraction d'Information Non Supervisée.* TAL (Traitement Automatique des Langues), 2013. **54** (2): pp.69-100.
16. Zweigenbaum, P., T. Lavergne, N. Grabar, T. Hamon, S. Rosset, and C. Grouin, *Combining an expert-based medical entity recognizer to a machine-learning system: methods and a case-study.* Biomedical Informatics Insights, 2013. pp.13p.

Books & chapters in books

1. Adda-Decker, M., L. Lamel, G. Adda, and T. Lavergne, *A first LVCSR system for Luxembourgish*, in *Human Language Technology Challenges for Computer Science and Linguistics - 5th Language and Technology Conference, LTC 2011, Poznan, Poland, November 25-27, 2011, Revised Selected Papers*, Vetulani Zygmunt and Mariani Joseph, Eds. 2014, Springer International Publishing. pp. 479-490.
2. Bellot, P., T. Bogers, S. Geva, M. Hall, H. Huurdeman, J. Kamps, G. Kazai, M. Koolen, V. Moriceau, J. Mothe, and X. Tannier, *Overview of INEX 2014*, in *Information Access Evaluation. Multilinguality, Multimodality, and Interaction, 5th International Conference of the CLEF Initiative, CLEF 2014.,* 2014. pp. 16.
3. Bellot, P., A. Doucet, S. Geva, S. Gurajada, J. Kamps, G. Kazai, M. Koolen, A. Mishra, V. Moriceau, J. Mothe, M. Preminger, E. SanJuan, R. Schenkel, X. Tannier, M. Theobald, M. Trappett, and Q. Wang, *Overview of INEX 2013*, in *Information Access Evaluation. Multilinguality, Multimodality, and Visualization*, Henning Müller Roberto Paredes Paolo Rosso Benno Stein Pamela Forner, Editor. 2013, Springer. pp. 269-281.
4. Bernhard, D. and A.-L. Ligozat, *Hassle-free POS-Tagging for the Alsatian dialects*, in *Special volume on Non-Standard Data Sources in Corpus Based-Research*, Zampieri Marcos and Diwersy Sascha, Eds. 2013, Shaker Verlag. pp. 8p.
5. Braffort, A. and M. Filhol, *Constraint-based Sign Language Processing*, in *Constraints and Language*, Henning Christiansen Verónica Dahl Denys Duchier Jørgen Villadsen Philippe Blache, Editor. 2014, Cambridge Scholar Publishing. pp. 191-217.
6. Deléger, L., B. Cartoni, and P. Zweigenbaum, *Paraphrase detection in monolingual specialized/lay comparable corpora*, in *Building and Using Comparable Corpora*, Reinhard Rapp Pierre Zweigenbaum Serge Sharoff and Fung Pascale, Eds. 2013, Springer. pp. 223-242.
7. Drouin, P., N. Grabar, T. Hamon, and K. kageura, *Proceedings of the 4th International Workshop on Computational Terminology* 2014. 135p.
8. Nedellec, C., R. Bossy, J.-D. Kim, J.-J. Kim, T. Ohta, S. Pyysalo, and P. Zweigenbaum, *Proceedings of the BioNLP Shared Task 2013 Workshop*. ACL ed 2013. 198p.
9. Sharoff, S., R. Rapp, and P. Zweigenbaum, *Proceedings of the Sixth Workshop on Building and Using Comparable Corpora* 2013. 145p.
10. Sharoff, S., R. Rapp, and P. Zweigenbaum, *Overviewing important aspects of the last twenty years of research in comparable corpora*, in *Building and Using Comparable Corpora*, Reinhard Rapp Pierre Zweigenbaum Serge Sharoff and Fung Pascale, Eds. 2013, Springer. pp. 1-20.
11. Sharoff, S., R. Rapp, P. Zweigenbaum, and P. Fung, *Building and Using Comparable Corpora* 2013: Springer. 335p.
12. Zweigenbaum, P. and C.O. Bagayoko, *Actes des 15es Journées francophones d'informatique médicale* 2014. 230p.
13. Zweigenbaum, P. and A. Geissbuhler, *Actes de la Session francophone d'informatique médicale pré-MEDINFO 2013* 2013. 81p.
14. Zweigenbaum, P., S. Sharoff, R. Rapp, A. Aker, and S. Vogel, *Proceedings of the 7th Workshop on building and using comparable corpora: comparable corpora and machine translation* 2014: ELRA. 64p.

Conferences with proceedings and review committee

1. Allauzen, A., N. Pécheux, Q.K. Do, M. Dinarelli, T. Lavergne, A. Max, H.S. Le, and F. Yvon. *LIMSI @ WMT13*. in *8th Workshop on Statistical Machine Translation (WMT 2013)*. 2013: ACL. 62-69.
2. Arnulphy, B., V. Claveau, X. Tannier, and A. Vilnat. *Techniques d'apprentissage supervisé pour l'extraction d'événements TimeML en anglais et français*. in *Conférence en Recherche d'Information et Applications*. 2014. Nancy, France. 8p.

3. Asadullah, M., P. Paroubek, and A. Vilnat. *Bidirectionnal converter between syntactic annotations : from French Treebank Dependencies to PASSAGE annotations, and back*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland: European Language Resources Association (ELRA). 2342-2347.
4. Asadullah, M., A. Vilnat, and P. Paroubek. *Converting from the French Treebank Dependencies into PASSAGE syntactic annotations*. in *Language & Technology Conference : Human Language Technologies as a Challenge for Computer Science and Linguistics*. 2013. Poznan, Pologne. 188-182.
5. Bellot, P., V. Moriceau, J. Mothe, E. SanJuan, and X. Tannier. *Évaluation de la contextualisation de tweets*. in *Conférence en Recherche d'Information et Applications*. 2013. Neuchâtel, Suisse. 1-8.
6. Bellot, P., V. Moriceau, J. Mothe, E. SanJuan, and X. Tannier. *Overview of the INEX Tweet Contextualization 2013 Track*. in *Conference and Labs of the Evaluation Forum*. 2013. Sheffield, UK. 6p.
7. Ben Abacha, A., P. Zweigenbaum, and A. Max. *Automatic Information Extraction in the Medical Domain by Cross-Lingual Projection*. in *IEEE International Conference on Healthcare Informatics*. 2013. Philadelphia, PA, USA: IEEE. 82-88.
8. Benamara, F., V. Moriceau, and Y.Y. Mathieu. *Catégorisation sémantique fine des expressions d'opinion pour la détection de consensus*. in *Atelier DEfi Fouilles de Textes (DEFT)*. 2014. Marseille, France. 1-9.
9. Bernhard, D. and A.-L. Ligozat. *Es esch fàscht wie Ditsch, oder net? Étiquetage morphosyntaxique de l'alsacien en passant par l'allemand*. in *Atelier Traitement Automatique des Langues Régionales de France et d'Europe (TALaRE 2013)*. 2013: Laboratoire d'Informatique de Nantes Atlantique/Laboratoire d'Informatique de l'Université du Maine. 12p.
10. Bodnari, A., L. Deléger, T. Lavergne, A. Névéol, and P. Zweigenbaum. *A supervised named-entity extraction system for medical text*. in *ShARe/CLEF eHealth Evaluation Lab*. 2013. Valencia, Spain. 8.
11. Bodnari, A., A. Névéol, Ö. Uzuner, P. Zweigenbaum, and P. Szolovits. *Multilingual named-entity recognition from parallel corpora*. in *Entity Recognition @ CLEF*. 2013. Valencia, Spain. 8.
12. Boros, E., R. Besançon, O. Ferret, and B. Grau. *Etiquetage en rôles événementiels fondé sur l'utilisation d'un modèle neuronal*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2014. Marseille. 11.
13. Boros, E., R. Besançon, O. Ferret, and B. Grau. *Event role extraction using domain-relevant word representations*. in *Conference on Empirical Methods in Natural Language Processing*. 2014. Doha, Qatar. 6.
14. Bouamor, D., A. Popescu, N. Semmar, and P. Zweigenbaum. *Building specialized bilingual lexicons using large scale background knowledge*. in *Conference on Empirical Methods in Natural Language Processing*. 2013. Seattle, Wa, USA. 479--489.
15. Bouamor, D., N. Semmar, and P. Zweigenbaum. *Context vector disambiguation for bilingual lexicon extraction from comparable corpora*. in *Annual Meeting of the Association for Computational Linguistics*. 2013. Sofia, Bulgaria. 759-764.
16. Bouamor, D., N. Semmar, and P. Zweigenbaum. *Using WordNet and semantic similarity for bilingual terminology mining from comparable corpora*. in *es and Evaluation - Workshop on Building and Using Comparable Corpora*. 2013. Sofia, Bulgaria. 16-23.
17. Bouamor, D., N. Semmar, and P. Zweigenbaum. *Towards a generic approach for bilingual lexicon extraction from comparable corpora*. in *Machine Translation Summit*. 2013. Nice, France. 143-150.
18. Braffort, A. *Eye gaze annotation practices: description vs. interpretation*. in *International Conference on Language Resources and Evaluation - Workshop on the Representation and Processing of Sign Languages*. 2014. Reykjavik, Iceland. 4p.
19. Braffort, A., M. Filhol, M. Delorme, L. Bolot, A. Choisier, and C. Verrecchia. *KAZOO: a sign language generation platform based on production rules*. in *International workshop on Sign Language translation and avatar technology*. 2013. Chicago, USA. 6p.
20. Brouwers, L., D. Bernhard, A.-L. Ligozat, and T. François. *Syntactic sentence simplification for French*. in *The 3rd Workshop on Predicting and Improving Text Readability for Target Reader Populations (PITR 2014)*. 2014: CLT. 10p.
21. Chatzimina, M.E., C. Grouin, and P. Zweigenbaum. *Use of unsupervised word classes for entity recognition: Application to the detection of disorders in clinical reports*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 8.
22. Claveau, V., T. Hamon, N. Grabar, and S. Le Maguer. *RePaLi participation to CLEF eHealth IR challenge 2014: leveraging term variation*. in *ShARe/CLEF eHealth Evaluation Lab*. 2014: University of Sheffield.
23. De Groc, C. and X. Tannier. *Apprendre à ordonner la frontière de crawl pour le crawling orienté*. in *Conférence en Recherche d'Information et Applications*. 2014. Nancy, France. 8p.
24. De Groc, C., X. Tannier, and C. De Loupy. *Thematic cohesion: measuring terms discriminatory power toward themes*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavík, Iceland. 5p.

25. Deléger, L., A.-L. Ligozat, C. Grouin, P. Zweigenbaum, and A. Névéol. *Annotation of specialized corpora using a comprehensive entity and relation scheme*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 8p.
26. Dhondt, E., B. Grau, S. Darmoni, A. Névéol, M. Schuers, and P. Zweigenbaum. *LIMSI @ 2014 Clinical Decision Support Track*. in *Text Retrieval Conference*. 2014. Gaithersburg, MD. 7.
27. Engström, C., T. Hamon, and S. Silvestrov. *Genetic algorithm-based tuning of the C-Value for term ranking*. in *International Conference on Stochastic Modeling Techniques and Data Analysis*. 2014. Lisbonne, Portugal. 12.
28. Falco, M.-H., V. Moriceau, and A. Vilnat. *Répondre à des questions à réponses multiples : premières expérimentations*. in *Conférence en Recherche d'Information et Applications*. 2013. Neuchâtel, Suisse. 337-352.
29. Falco, M.-H., V. Moriceau, and A. Vilnat. *Évaluation d'un système d'extraction de réponses multiples sur le Web par comparaison à des humains*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2014. Marseille, France. 1-6.
30. Filhol, M. *Grammaire récursive non linéaire pour les langues des signes*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2014. Marseille, France. 6.
31. Filhol, M., M.N. Hadjadj, and A. Choisier. *Non-manual features: the right to indifference*. in *International Conference on Language Resources and Evaluation - Workshop on the Representation and Processing of Sign Languages : Beyond the manual channel*. 2014. Reykjavik, Iceland. 6p.
32. Filhol, M., M.N. Hadjadj, and B. Testu. *A rule triggering system for automatic text-to-Sign translation*. in *International workshop on Sign Language translation and avatar technology*. 2013. Chicago, USA: Rosalee J. Wolfe. 6p.
33. Filhol, M. and X. Tannier. *Construction of a French-LSF corpus*. in *International Conference on Language Resources and Evaluation - Workshop on Building and Using Comparable Corpora Building Resources for Machine Translation Research (BUCC)*. 2014. Reykjavík, Iceland. 4p.
34. Filhol, M. and X. Tannier. *Construction of a French-LSF corpus*. in *International Conference on Language Resources and Evaluation - Workshop on Building and Using Comparable Corpora Building Resources for Machine Translation Research (BUCC)*. 2014. Reykjavik, Iceland. 4p.
35. Fraisse, A. and P. Paroubek. *Toward a unifying model for opinion, sentiment and emotion information extraction*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland: European Language Resources Association (ELRA). 3881-3886.

36. Fraisse, A. and P. Paroubek. *Twitter as a Comparable Corpus to build Multilingual Affective Lexicons*. in *International Conference on Language Resources and Evaluation - Workshop on Building and Using Comparable Corpora Building Resources for Machine Translation Research (BUCC)*. 2014. Reykjavik, Iceland: European Language Resources Association (ELRA). 17-21.
37. Fraisse, A., P. Paroubek, and G. Francopoulo. *L'apport des Entités Nommées pour la classification des opinions minoritaires*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Les Sables d'Olonne, France. 588-595.
38. Garcia-Fernandez, A., A.-L. Ligozat, and A. Vilnat. *Construction and annotation of a french folkstale corpus*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 6p.
39. Gleize, M. and B. Grau. *LIMSIILES: Basic English Substitution for Student Answer Assessment at SemEval 2013*. in *Seventh International Workshop on Semantic Evaluation*. 2013: ACL.
40. Gleize, M. and B. Grau. *A hierarchical taxonomy for classifying hardness of inference tasks*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland: European Language Resources Association. 7p.
41. Gleize, M., B. Grau, A.-L. Ligozat, V.-M. Pho, G. Illouz, F. Gianetti, and L. Lahondes. *Selecting answers with structured lexical expansion and discourse relations LIMSI's participation at QA4MRE 2013*. in *QA4MRE Workshop*. 2013.
42. Gleize, M., A.-L. Ligozat, and B. Grau. *LIMSI-CNRS@CLEF 2014: Invalidating answers for multiple choice question answering*. in *Question Answering Track*. 2014. 1386-1394.
43. Gong, L., A. Max, and F. Yvon. *Vers un développement plus efficace des systèmes de traduction statistique : un peu de vert dans un monde de BLEU*. in *Traitement Automatique du Langage Naturel*. 2014. Marseilles, France. 395-400.
44. Gong, L., A. Max, and F. Yvon. *Incremental Development of Statistical Machine Translation Systems*. in *International Workshop on Spoken Language Translation*. 2014. South Lake Tahoe, CA. 214--222.
45. Goryainova, M., C. Grouin, S. Rosset, and I. Vasilescu. *Morpho-Syntactic Study of Errors from Speech Recognition System*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 5p.
46. Grabar, N. and T. Hamon. *Automatic extraction of layman names for technical medical terms*. in *IEEE International Conference on Healthcare Informatics*. 2014. Verona, Italy. 10.

47. Grabar, N. and T. Hamon. *Unsupervised method for the acquisition of general language paraphrases for medical compounds*. in *International Workshop on Computational Terminology*. 2014: Dublin City University. 94-103.
48. Grabar, N., T. Hamon, and D. Amiot. *Automatic diagnosis of understanding of medical words*. in *Workshop on Predicting and Improving Text Readability for Target Reader Populations*. 2014. Gothenburg, Sweden. 11-20.
49. Grabar, N., I. van Zyl, R. de la Harpe, and T. Hamon. *The comprehension of medical words: Cross-lingual experiments in French and Xhosa*. in *International Conference on Health Informatics*. 2014. Angers, France: SCITEPRESS Digital Library. 1-8.
50. Grau, B., A.-L. Ligozat, and V.-M. Pho. *Réponse à des tests de compréhension*. in *Conférence en Recherche d'Information et Applications*. 2013. Neuchâtel, Suisse. 1-10.
51. Grouin, C. *Building a contrasting taxa extractor for relation identification from assertions: biological taxonomy & ontology phrase extraction system*. in *BioNLP Shared-Task Workshop (BioNLP 2013)*. 2013: ACL. 1-9.
52. Grouin, C. *Biomedical entity extraction using machine-learning based approaches*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 6p.
53. Grouin, C. *Clinical records de-identification using CRF and rule-based approaches*. in *i2b2/UTHealth NLP Workshop*. 2014: LIMSI. 5.
54. Grouin, C. *Identification of medication side effects in clinical records: an experiment based on the 2014 i2b2/UTHealth corpus*. in *i2b2/UTHealth NLP Workshop*. 2014: LIMSI. 5.
55. Grouin, C., T. Lavergne, and A. Névéol. *Optimizing annotation efforts to build reliable annotated corpora for training statistical models*. in *Linguistic Annotation Workshop*. 2014. Dublin, Ireland. 54-58.
56. Grouin, C., V. Moriceau, S. Rosset, and P. Zweigenbaum. *Risk factor identification from clinical records for diabetic patients*. in *i2b2/UTHealth NLP Workshop*. 2014: LIMSI. 5.
57. Grouin, C., P. Paroubek, and P. Zweigenbaum. *DEFT2013 se met à table : présentation du défi et résultats*. in *9th Atelier DEfi Fouilles de Textes (DEFT 2013)*. 2013: ATALA. 14p.
58. Grouin, C. and P. Zweigenbaum. *Automatic De-Identification of French clinical records: comparison of rule-based and machine-learning approaches*. in *International Congress on Medical Informatics*. 2013. Copenhagen, Denmark: IOS Press. 1-5.
59. Gueniat, F., M. Delorme, L. Pastur, and f. lusseyrand. *Décomposition en modes dynamiques économique pour l'identification de structures cohérentes dans des écoulements 3D*. in *Rencontre du Non-Linéaire*. 2013. Paris. 6p.
60. Hamon, T., C. Engström, and S. Silvestrov. *Term ranking adaptation to the domain: genetic algorithm based optimisation of the C-Value*. in *International Conference on Natural Language Processing*. 2014. Warsaw, Poland: Springer. 71-83.
61. Hamon, T. and N. Grabar. *Tuning HeidelTime for identifying time expressions in clinical texts in English and French*. in *International Workshop on Health Text Mining and Information Analysis*. 2014. Gothenburg, Sweden. 101-105.
62. Hamon, T., N. Grabar, and F. Mougin. *Natural language question analysis for querying biomedical linked data*. in *Natural Language Question Analysis for Querying Biomedical Linked Data*. 2014: projet POMELO. 16.
63. Hamon, T., N. Grabar, and F. Mougin. *Description of the POMELO system for the task 2 of QALD-2014*. in *ShARe/CLEF Question/Answering Evaluation Lab*. 2014: University of Sheffield. 12.
64. Hamon, T., C. Grouin, and P. Zweigenbaum. *Disease and disorder template filling using rule-based and statistical approaches*. in *ShARe/CLEF eHealth Evaluation Lab*. 2014. Sheffield, United Kingdom. 12.
65. Hamon, T., Q. Pleplé, P. Paroubek, P. Zweigenbaum, and C. Grouin. *Analyse automatique de textes littéraires et scientifiques : présentation et résultats du défi fouille de texte DEFT2014*. in *Atelier DEfi Fouilles de Textes (DEFT)*. 2014. Marseille. 10.
66. Hamon, T., Q. Pleplé, P. Paroubek, P. Zweigenbaum, and C. Grouin. *Analyse automatique de textes littéraires et scientifiques : présentation et résultats du défi fouille de texte DEFT2014*. in *Défi Fouille de texte*. 2014: Université Aix-Marseille. 1-10.
67. Jimeno Yepes, A. and A. Névéol. *Effect of additional in-domain parallel corpora in biomedical statistical machine translation*. in *4th International Louhi Workshop on Health Document Text Mining and Information Analysis (Louhi2013)*. 2013: NICTA. 6p.
68. Karanasou, P., F. Yvon, T. Lavergne, and L. Lamel. *Discriminative training of a phoneme confusion model for a dynamic lexicon in ASR*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 5p.
69. Lavergne, T., G. Adda, M. Adda-Decker, and L. Lamel. *Automatic language identity tagging on word and sentence-level in multilingual text sources: a case-study on Luxembourgish*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 5.

70. Lavergne, T., A. Allauzen, and F. Yvon. *un cadre d'apprentissage intégralement discriminant pour la traduction statistique*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Les Sables d'Olonne. 14p.
71. Lavergne, T., G. Illouz, A. Max, and R. Nagata. *LIMSI's participation in the 2013 shared task on native language identification*. in *8th Workshop on Building Educational Applications Using NLP (BEA 2013)*. 2013: ACL. 6p.
72. Lehnen, P., A. Allauzen, T. Lavergne, F. Yvon, S. Hahn, and H. Ney. *Structure learning in hidden conditional random fields for grapheme-to-phoneme conversion*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 5p.
73. Letard, V., S. Rosset, and G. Illouz. *A mapping-based approach for general formal human computer interaction using natural language*. in *Annual Meeting of the Association for Computational Linguistics*. 2014. Baltimore, Maryland, USA. 34-40.
74. Ligozat, A.-L. *Classification de questions par traduction*. in *Conférence en Recherche d'Information et Applications*. 2013. Neuchâtel, Suisse. 1-10.
75. Ligozat, A.-L. *Question classification transfer*. in *Annual Meeting of the Association for Computational Linguistics*. 2013. Sofia, Bulgarie. 5p.
76. Ligozat, A.-L., C. Grouin, A. Garcia-Fernandez, and D. Bernhard. *Approches à base de fréquences pour la simplification lexicale*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Les Sables-d'Olonne, France. 1-14.
77. Ligozat, A.-L., V.-M. Pho, T. Andre, B. Grau, G. Illouz, and T. François. *Multiple Choice Question Corpus Analysis for Distractor Characterization*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 8p.
78. Luzzati, D., C. Grouin, I. Vasilescu, M. Adda-Decker, E. Bilinski, N. Camelin, J. Kahn, C. Lailler, L. Lamel, and S. Rosset. *Human annotation of ASR error regions: Is "gravity" a sharable concept for human annotators?* in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 7p.
79. Marchand, M. *Fouille d'opinion : ces mots qui changent de polarité selon le domaine*. in *Rencontres Jeunes Chercheurs en Recherche d'Information*. 2013. Neuchâtel, Suisse. 6.
80. Marchand, M., R. Besançon, O. Mesnard, and A. Vilnat. *Domain adaptation for opinion mining: a study of multi-polarity words*. in *2nd Workshop on Practice and Theory of Opinion Mining and Sentiment Analysis*. 2013: Gesellschaft für Sprachtechnologie und Computerlinguistik. 17-31.
81. Marchand, M., R. Besançon, O. Mesnard, and A. Vilnat. *Influence des marqueurs multi-polaires dépendant du domaine pour la fouille d'opinion au niveau du texte*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2014. Marseille. 12.
82. Mariani, J.-J., C. Cieri, G. Francopoulo, P. Paroubek, and M. Delaborde. *Facing the identification problem in language-related scientific data analysis*. in *Language Resources and Evaluation 2014*. 2014. Reykjavik, Islande. 7.
83. Mariani, J.-J., P. Paroubek, G. Francopoulo, and M. Delaborde. *Rediscovering 25 years of discoveries in spoken language processing: a preliminary analysis of the ISCA archive*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 33p.
84. Marie, B. and A. Max. *A study in greedy oracle improvement of translation hypotheses*. in *International Workshop on Spoken Language Translation*. 2013. Heidelberg, Germany. 8p.
85. Marie, B. and A. Max. *Confidence-based Rewriting of Machine Translation Output*. in *Conference on Empirical Methods in Natural Language Processing*. 2014. Doha, Qatar: Association for Computational Linguistics. 1261-1272.
86. Max, A., L. Gong, and F. Yvon. *Construction (très) rapide de tables de traduction à partir de grands bi-textes*. in *Traitement Automatique du Langage Naturel*. 2014. Marseille, France. 26-27.
87. Metz, L., V. Zampa, and A. Braffort. *Plat'in : Plateforme pour l'apprentissage de la LSF, étude préliminaire et spécification*. in *Atelier EIAH et Situations de handicap*. 2013: Association des technologies de l'information pour l'Education et la formation. 9-14.
88. Moriceau, V. and X. Tannier. *French resources for extraction and normalization of temporal expressions with HeidelTime*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavík, Iceland. 5p.
89. Nedellec, C., R. Bossy, J.-D. Kim, J.-J. Kim, T. Ohta, S. Pyysalo, and P. Zweigenbaum. *Overview of BioNLP Shared Task 2013*. in *BioNLP Shared-Task Workshop*. 2013. Sofia, Bulgaria. 1-7.
90. Névéol, A., H. Dalianis, G. Savova, and P. Zweigenbaum. *Didactic Panel: Clinical Natural Language Processing in Languages Other Than English*. in *AMIA Annual Symposium*. 2014. Washington, DC. 3.
91. Névéol, A., J. Grosjean, J. Darmoni, and P. Zweigenbaum. *Language resources for French in the biomedical domain*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 2146-2151.

92. Névéol, A., C. Grouin, S. Darmoni, and P. Zweigenbaum. *Désidentification d'un corpus clinique pour le traitement automatique du français*. in *1st SIG IMIA Francophone*. 2013: International Medical Informatics Association. 2p.
93. Névéol, A., C. Grouin, J. Leixa, S. Rosset, and P. Zweigenbaum. *The Quaero french medical corpus: a ressource for medical entity recognition and normalization*. in *Bio text-mining workshop*. 2014. Reykjavik, Iceland. 7p.
94. Névéol, A., A. Max, Y. Ivanishcheva, P. Ravaud, P. Zweigenbaum, and F. Yvon. *Statistical machine translation of systematic reviews into French*. in *Workshop on Optimizing understanding in multilingual hospital encounters*. 2013: Université Paris 13. 4p.
95. Névéol, A., D. Rebholz-Schuhmann, and P. Zweigenbaum. *An overview of terminological resources available for French bioNLP*. in *Entity Recognition @ CLEF*. 2013. Valencia, Spain. 7.
96. Nguyen, K.-H., X. Tannier, and V. Moriceau. *Ranking multidocument event descriptions for building thematic timelines*. in *International Conference on Computational Linguistics*. 2014. Dublin, Ireland. 9.
97. Paroubek, P., M. Asadullah, and D. Nouvel. *Using verb-noun patterns to detect process inputs*. in *International Conference on Text, Speech and Dialogue*. 2014. Brno, Czech Republic: Springer. 181-188.
98. Paroubek, P., M. Asadullah, and A. Vilnat. *Convertir des analyses syntaxiques en dépendances vers les relations fonctionnelles PASSAGE*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Les Sables d'Olonne, France. 675-682.
99. Pécheux, N., L. Gong, Q.K. Do, B. Marie, Y. Ivanishcheva, A. Allauzen, T. Lavergne, J. Niehues, A. Max, and F. Yvon. *LIMSI @ WMT'14 Medical Translation Task*. in *9th Workshop on Statistical Machine Translation (WMT 2014)*. 2014: ACL. 8.
100. Périnet, A. and T. Hamon. *Analyse et proposition de paramètres distributionnels adaptés aux corpus de spécialité*. in *International Conference Journées d'Analyse statistique des Données Textuelles*. 2014. Paris, France. 507-518.
101. Périnet, A. and T. Hamon. *Reducing VSM data sparseness by generalizing contexts: application to health text mining*. in *International Workshop on Health Text Mining and Information Analysis*. 2014. Gothenburg, Sweden. 90-95.
102. Périnet, A. and T. Hamon. *Distributional context generalisation and normalisation as a mean to reduce data sparsity: evaluation of medical corpora*. in *International Conference on Natural Language Processing*. 2014. Warsaw, Poland: Springer. 128-135.
103. Périnet, A. and T. Hamon. *Réduction de la dispersion des données par généralisation des contextes distributionnels : application aux textes de spécialité*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2014. Marseille, France. 232-243.
104. Rosset, S., C. Grouin, T. Lavergne, M. Ben Jannet, J. Leixa, O. Galibert, and P. Zweigenbaum. *Automatic named entity pre-annotation for out-of-domain human annotation*. in *Linguistic Annotation Workshop*. 2013. Sofia, Bulgaria: ACL. 10p.
105. Sadoun, D., C. Dubois, Y. Ghamri-Doudane, and B. Grau. *Peuplement d'une ontologie guidé par l'identification d'instances de propriété*. in *International Conference on Terminology and Artificial Intelligence*. 2013. Université Paris 13 - Villetaneuse. 145-152.
106. Sadoun, D., C. Dubois, Y. Ghamri-Doudane, and B. Grau. *From natural language requirements to formal specification using an ontology*. in *IEEE International Conference on Tools with Artificial Intelligence*. 2013. Washington, USA. 145-160.
107. Sadoun, D., C. Dubois, Y. Ghamri-Doudane, and B. Grau. *Formal Rule Representation and Verification from Natural Language Requirements Using an Ontology*. in *International Symposium, RuleML 2014 Co-located with the 21st European Conference on Artificial Intelligence, ECAI 2014*. 2014. Prague, République Tchèque: Springer. 226–235.
108. Tannier, X. *Extracting news web page creation time with DCTFinder*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavík, Iceland. 5p.
109. Tannier, X. and C. De Groc. *Evaluating web-as-corpus topical document retrieval with an index of the OpenDirectory*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavík, Iceland. 5p.
110. Tannier, X. and V. Moriceau. *Building event threads out of multiple news articles*. in *Conference on Empirical Methods in Natural Language Processing*. 2013. Seattle, USA. 1-10.
111. Tannier, X., V. Moriceau, and E. Le Flem. *Une interface pour la validation et l'évaluation de chronologies thématiques*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Sables d'Olonne. 2p.
112. Todirascu, A., T. François, N. Gala, C. Fairon, A.-L. Ligozat, and D. Bernhard. *Coherence and cohesion for the assessment of text readability*. in *International Workshop on Natural Language Processing and Cognitive Science*. 2013. Marseille, France. 9p.

113. Wang, W., R. Besançon, O. Ferret, and B. Grau. *Regroupement sémantique de relations pour l'extraction d'information non supervisée*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Les Sables d'Olonne, France. 353–366.
114. Wang, W., R. Besançon, O. Ferret, and B. Grau. *Semantic clustering of relations between named entities*. in *International conference on Natural Language Processing*. 2014. Warsaw, Poland: Springer. 13.
115. Zweigenbaum, P. *Apport des classes de mots induites à la détection supervisée d'entités nommées: succès et limites*. in *Congrès international des linguistes*. 2013. Genève, Suisse. 1.
116. Zweigenbaum, P. *Revisiting comparable corpora in connected space*. in *Workshop on Building and Using Comparable Corpora*. 2014. Reykjavik, Iceland. 60-69.
117. Zweigenbaum, P., L. Deléger, T. Lavergne, A. Névéol, and A. Bodnari. *A supervised abbreviation resolution system for medical text*. in *ShARe/CLEF eHealth Evaluation Lab*. 2013. Valencia, Spain. 10.
118. Zweigenbaum, P. and C. Grouin. *Reformatting clinical records based on global layout statistics*. in *International Symposium on Semantic Mining in Biomedicine*. 2014. Aveiro, Portugal. 8.
119. Zweigenbaum, P. and X. Tannier. *Extraction des relations temporelles entre événements médicaux dans des comptes rendus hospitaliers*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Sables d'Olonne, France. 1-8.

Conferences without proceedings, workshops

1. Bouamor, D., N. Semmar, and P. Zweigenbaum. *Utilisation de la similarité sémantique pour l'extraction de lexiques bilingues à partir de corpus comparables*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Les Sables d'Olonne. 327-338.
2. Braffort, A., T. Hanke, M. Huenerfauth, and R. Wolfe. *Signing avatars - The past and the future*. in *Signing Creatures Workshop*. 2013. Washington D.C., USA.
3. Grouin, C., *Protocole et expériences d'anonymisation des données personnelles contenues dans les comptes-rendus hospitaliers*, in *Séminaire Anonymisation de corpus*2014, HdR MSH Lorraine.
4. Max, A., A. Névéol, F. Yvon, P. Zweigenbaum, and P. Ravaud. *Traduction automatique en français des revues Cochrane*. in *1st SIG IMIA Francophone*. 2013: International Medical Informatics Association. 5p.
5. Metz, L., V. Zampa, and A. Braffort. *Plat'in : Plateforme d'enseignement/apprentissage de la Langue des Signes Française*. in *Journées Tice Alpes 2013 - "De l'artisanat à l'ingénierie"*. 2013. Grenoble, France.
6. Rosset, S., D. Luzzati, C. Grouin, I. Vasilescu, M. Adda-Decker, E. Bilinski, N. Camelin, J. Kahn, C. Lailler, and L. Lamel. *Human annotation of ASR error regions: Is 'gravity' a sharable concept for human annotators?* in *Errors by Humans and Machines in Multimedia, Multimodal, Multilingual Data Processing*. 2013. Ermenonville, France.

TLP
Spoken Language Processing

JEAN-LUC GAUVAIN

The Spoken Language Processing group carries out research aimed at understanding the human speech communication processes and developing models for use in automatic processing of speech. This research is by nature interdisciplinary, drawing upon expertise in signal processing, acoustic-phonetics, phonology, semantics, statistics and computer science. The group's research activities are validated by developing systems for automatic processing of spoken language such as speech recognition, language identification, multimodal characterization of speakers and their affective state, named-entity extraction and question-answering, spoken dialog, multimodal indexation of audio and video documents, and machine translation of both spoken and written language.

With the aim of extracting and structuring information in audio documents, the group develops models and algorithms that use diverse sources of information to carry out a global decoding of the signal, that can be applied to identify the speaker, the language being spoken if it is not known a priori, the affect, to transcribe the speech or translate it, or identify specific entities.

The research of the group is structured in seven interdependent topics: Speaker characterization in a multimodal context (Topic 1); Affective and social dimensions of spoken interactions (Topic 2); Perception and automatic processing of variation in speech (Topic 3); Robust analysis of spoken language and dialog systems (Topic 4); Translation and machine learning (Topic 5); Speech recognition (Topic 6); Language resources (Topic 7).

Speaker recognition (Topic 1) consists of determining who spoke when, where the identity can be that of the true speaker or an identity specific to one document or a set of documents. Different sources of information (the speaker's voice, what is said, or what is written) can be used to identify the speaker in multimedia documents, as investigated by the REPERE challenge in which the group led the QCOMPERE consortium.

Affective and social dimension detection (Topic 2) are being applied to both human-machine interaction with robots and in the analysis of audiovisual and audio documents. The main research subjects addressed are emotion and social cue identification in human-robot interaction, emotion detection based on verbal and non verbal cues (acoustic, visual and multimodal), dynamic user profile (emotional and interactional dimensions) in dialog for assistive robotics, and multimodal detection of the anxiety applied to therapeutic serious games.

In topic 3, the very large corpora used for training statistical models are also exploited for linguistic studies of spoken language, such as acoustic-phonetics, pronunciation variation and diacronic evolution. Automatic alignment enables studies on hundreds to thousands of hours of data, permitting the validation of hypotheses and models. Human and machine transcription errors are studied and compared via perception experiments.

Robust analysis methods (Topic 4) for the spoken language are developed in the framework of open domain information retrieval with applications to language understanding for dialog systems, to named-entity recognition, and to interactive question answering systems supporting both spoken and written languages. Robust analysis also includes modeling and detecting speech disfluences.

This activities on statistical machine translation (Topic 5) of speech or text focuses on design and development of novel language and translation models as well as novel decoding strategies and is closely related to the development of machine learning methodologies. Machine translation of both speech and text input also involves many intermediate sub-tasks such as part-of-speech tagging and syntactic analysis, that can also be tackled with machine learning tools.

Speech recognition (Topic 6) is the process of transcribing the speech signal into text. Depending upon the targeted use, the transcription can be completed with punctuation, with paralinguistic information such as hesitations, laughter or breath noises. Research on speech recognition relies on supporting research in acoustic-phonetic modeling, lexical modeling and language modeling (a problem in common with machine translation), which are undertaken in a multilingual context (18 languages).

In addition to the collection, annotation and sharing of varied corpora, Topic 7 addresses more general investigations on Language Resources, covering data, tools, evaluation and meta-resources (guidelines, methodologies, metadata, best practice), for spoken and written language, but also for multilingual, multimodal, and mutimedia data. Those activities are mostly conducted in collaboration with national and international organizations and networks.

For the reporting period the members of the group published 167 articles (23 in journals, 20 chapters in books, and 124 reviewed papers mostly at major international conferences) and has edited 2 books and contributed to edition of InterSpeech 2013 conference proceedings. As Interspeech 2013 was being held in Lyon, several group members were strongly involved in the organization holding important roles such as Technical Program Chair, Special Events Coordinator, Finance Manager and Prospective Committee Coordinator. Also as part of its educational activities the group is responsible for several graduate level speech processing courses, principally at the University of Paris-Sud.

A recurrent activity in the group is our participation to international evaluations on speech and language technologies. These include speaker recognition (SRE'13), multimodal speaker recognition (Repere 2013), machine translation (WMT 2013, 2014), IWSLT 2014. We are part of the BBN-led Babelon team which obtained the best results in the 2013 and 2014 iARPA Babel evaluations for most conditions. The group has a long history of strong implication in collaborative projects at the national and international level (see below). During this period we contributed to 16 projects, in particular leading the CTC project of the Quaero program. In addition, we contributed to the "Commission de réflexion sur l'Ethique de la Recherche en Sciences et Technologies du Numérique" (CERNA) within the Allistene alliance, the Fostering Language Resources Network (FLaReNet), and the Multilingual Europe Technology Network (Meta-Net).

Research activities

Topic 1: Speaker characterization in a multimodal context

Claude Barras, Hervé Bredin, Cong-Thanh Do, Jean-Luc Gauvain, Camille Guinaudeau, Lori Lamel, Johann Poignant, Anindya Roy, Achintya Sarkar

Most state-of-the-art automatic speaker recognition systems model the short-term spectral characteristics of the speech signal, focusing mainly on the timbre information, even though prosody, accent or idiomatic expressions can also provide cues for speaker characterization. Gaussian Mixture Models (GMM), serving as a generic model of speech, are usually a building block of such a system, in combination with other models such as Support Vector Machines (SVM) or the i-vectors. Since 2002, we have participated to the international evaluations on speaker verification organized by the NIST (National Institute of Standard and Technologies, USA), with a focus on studying the use of MLLR (Maximum Likelihood Linear Regression) speaker adaptation as features for speaker recognition. In addition to well-known applications to security, access control and forensics, speaker recognition is also useful for audiovisual document analysis, structuring multimedia content, and for multimodal applications. Speaker diarization, defined as the automatic acoustic segmentation and clustering into speaker turns, can enrich an automatic transcription and improve its readability and more generally to characterize audiovisual archives. Integration of speaker recognition approaches in a diarization system proved to be fruitful, resulting in state-of-the-art performance in several national and international evaluations. We extended our approach to collections of shows, such as digital libraries or multimedia archives, where it is important that a given speaker shares the same identifier in all audio documents. We explored several architectures for cross-show diarization, comparing a global clustering with incremental approaches.

There are cases where voice is not the only cue available to identify a speaker. In TV broadcast news or talk shows for instance, the identities of guests or reporters are often provided as a text overlay that can be automatically extracted using video optical character recognition (OCR). Similarly, it is common practice for anchors to introduce their guests by saying their name. In the framework of the QCOMPERE consortium for the REPERE challenge, we were able to greatly improve the performance of our supervised speaker identification system by combining these multimodal cues. Most importantly, the use of multiple information sources lays the groundwork for unsupervised speaker identification systems when little or no data is available to train speaker models.

We proposed a completely unsupervised multimodal speaker identification system which used the video OCR to name the clusters produced by our state-of-the-art speaker diarization system. This unsupervised multimodal approach was shown to get very close performance to that of a supervised acoustic-only speaker identification system. Moreover, we showed that when audio is the only available modality, combining approaches (supervised and unsupervised), that is adding person named entity detection followed by addressee detection, could lead to a significant improvement over a state-of-the-art i-vector-based speaker diarization system.

In collaboration with the Institut de Recherche en Informatique de Toulouse, speaker diarization also proved to be very helpful providing most of the building blocks for a novel approach to automatic summarization of TV shows. First, a graph-based system for temporal segmentation into scenes is based on the multimodal fusion of color information, speaker diarization and automatic speech transcription. A comparative study of three scene segmentation approaches used with the three different modalities (audio, video and automatic transcripts) was conducted, showing that the audio modality obtained the best results. As modern TV shows usually contain multiple interlaced stories, a semantic plot de-interlacing step uses the speaker diarization with other cues to group semantically similar scenes into coherent stories. The final. ongoing step aims at summarizing each detected story in a short self-contained video excerpt for easy browsing.

Topic 2: Affective and social dimensions of spoken interactions

Laurence Devillers, Lucile Bechade, Eric Bilinski, Clément Chastagnol, Agnès Delaborde, Guillaume Duplessis-Dubuisson, Clément Gossart, Joseph Mariani, Mohamed Sehili, Mariette Soury, Marie Tahon, Ioana Vasilescu, Fan Yang

Our research activities in this theme are focused on developing and testing the affective and social dimensions of interaction, where detection and interpretation are applied to both human-machine (robots or agents) interactions and to the analysis of audiovisual/audio data. In order to design affective and social interactive systems, experimental grounding is required to study expressions of emotion and social cues during interaction. The non-verbal information, particularly audio, plays an essential role in human communication but undoubtedly, complementary emotional information exists in other modalities. The main research subjects developed are the identification of emotion and social cues, dynamic user profiling (emotional and interactional dimension interpretation in dialog), multimodal detection of emotion and the ethics guidelines for researchers in robotics.

Most of the affective states recognition systems are trained on artificial data, without any realistic context. Moreover the evaluations are done with pre-recorded data of the same quality. The work on speech in this theme introduced in 2001 has been based on the use of genuinely natural speech material. Our team was one of the first to grasp the issue and is one among a very small number of research sites to have consistently taken on the challenge of finding, annotating and analyzing real-life emotional data (financial consultations, medical emergency calls, and human-robot and human-agent interactions). Studies were led on various classes of emotions: anger, stress, anxiety, sadness and positive feelings but also on valence and activation dimensions, and affective and social markers (laughs, smiles, breaths or filler pauses). Analysis techniques which extracted spectral, prosodic and affect burst markers and automatic emotion detection systems using sophisticated machine learning techniques such as Support Vector Machines (SVM) have been developed.

Since real-life environments vary in multiple ways during human-machine interactions (speaker, acoustic environment, interaction, emotional task), emotion recognition systems face a large diversity of contexts. Our goal was to select the most consensual acoustic family for emotions recognition via corpus comparison. In order to obtain close-to-reality spontaneous emotional data, data was collected using systems simulating a natural interaction using an expressive virtual character, as well as interacting with the robot Nao. In the French FUI ROMEO project, we investigated different feature combinations in cross-corpus experiments of human-robot interaction with visually impaired adults and children (PhD work of M. Tahon). Emotional corpora were also gathered with an agent, featuring almost 80 patients from medical centers (French ANR ARMEN project). Most of this work dealt with automatic selection of the best features. A hybrid algorithm combining floating selection techniques with similarity measures and multi-scale heuristics was proposed and used in the InterSpeech 2012 Emotion Challenge. The results and insights obtained with this algorithm suggested ways of distinguishing between emotional corpora using their most relevant features. A prototype of a complete dialog system including the emotion detection module and the virtual agent was also implemented (PhD work of C. Chastagnol).

Beyond an isolated paralinguistic detection, we built a dynamic user profile which evolves throughout the interaction. This profile allows the machine's response strategy to be adapted, and can deal with long term relationships. The profile consists of several dimensions such as optimism, extroversion, emotional stability, self-confidence, affinity and dominance based on the OCEAN personality model and the interpersonal circumflex theories. The information derived from this profile allow the engagement of the speaker to be measured. The social behavior of the system was adapted according to the profile and the

current task state and the robot behavior. Fuzzy logic rules drive the constitution of the profile and automatic selection of the robotic behavior. These rules were implemented in the decision engine in the ROMEO project with NAO (PhD work of A. Delaborde). An excerpt of the movie LivingWithRobot (2012) shows the emotion detection and user profile systems: https://www.youtube.com/watch?v=p1ID-gvUnWs.

We also explored automatic recognition of human stress during stress-inducing interactions, such as public speaking, job interviews and serious games)(FEDER E-therapies project), using audio and visual cues captured via a webcam, or subjects' posture captured via a Kinect. We evaluated stress in various populations: social phobics and apathologic subjects. Inter-individual and inter-corpora comparisons highlight the variability of stress expression. A possible application of this work could be the elaboration of therapeutic software to teach stress coping strategies, particularly for social phobics (PhD work of M. Soury). In the framework of the ANR EMCO COMPARSE project (2012-15) and in collaboration with CPU group, we are studying the relationships between cognition, motivation, and personality for emotional adaptation and regulation, using empathic virtual simulation.

Ethical issues, including safety, privacy and dependability of robot behaviour, are attracting the attention of researchers, with the growing realization that addressing these issues must accompany the scientific and technological development of robots, to ensure the harmony and acceptability of their relation with the human beings. We are involved in the Ethical working group for research in robotics of CERNA (Allistene) (Report n°1 – November 2014:
http://cerna-ethics-allistene.org/digitalAssets/38/38704_Avis_robotique_livret.pdf).

Our on-going researches concern fusion between audio and visual cues, linguistic and paralinguistic channels, adaptation learning techniques, long-term relationship, social interaction and dialog with robots and ethics. We are currently involved in two projects on affective and social robotics: - The OSEO PSPC ROMEO2 (2013-17) which has the main goal of building a social humanoid robot (ROMEO robot developed by Aldebaran Robotics) which can act as a comprehensive assistant to help persons suffering from autonomy loss. - The European CHISTERA project JOKER (2014-17), JOKe and Empathy of a Robot/ECA: Towards social and affective relations with a robot, will emphasize the fusion of verbal and non-verbal channels for emotional and social behavior perception, interaction and generation capabilities: https://lejournal.cnrs.fr/articles/les-robots-ont-ils-le-sens-de-lhumour.

Topic 3: Perception and automatic processing of variation in speech

Philippe Boula de Mareüil, Ioana Vasilescu, Martine Adda-Decker, Lori Lamel, Sophie Rosset, Maria Candea, Ioana Chitoran, Camille Dutrey

In speech communication, considerable variability comes into play, raising issues for both humans and machines. This research topic aims to increase our knowledge about variation in speech and to improve the performance of automatic speech processing systems. The study of variation in speech (socially constructed, correlating to speaker groups or situations) can also benefit from technological advances, since its study requires large-scale phonetic analyses. Our research objectives are pursued via the following axes: (1) analysis of variation factors as reflected by multilingual speech in large-scale corpora; (2) human-machine comparison in different tasks in relation with automatic speech processing and (3) analysis of accents and speaking styles.

The first axis is illustrated by the acoustic and prosodic description of large multilingual corpora, focusing on both lexical and extra-lexical phenomena. We are interested in exploring speech variation phenomena which demonstrate the evolution of language and consider inter- and intra-speaker variants in close connection with speech processing systems. During this reporting period, we focused on

Romanian, a less-resourced language. Speech processing tools were applied to investigate morpho-phonetic trends in contemporary spoken Romanian, with the objective of improving the pronunciation dictionary and more generally, the acoustic models of a speech recognition system. Two aspects of the Romanian morpho-phonology were investigated based on this analysis: the deletion of the masculine definite article -l and the secondary palatalization of plural nouns and adjectives and of 2nd person indicative of verbs. This work was carried out in collaboration with Ioana Chitoran (University Paris Diderot). A second topic has been dedicated to the characterization and automatic detection of disfluencies in the difficult context of the EDF call-center data (PhD work of C. Dutrey). After first defining disfluency patterns using both linguistic and acoustic features, an automatic system for the detection of edit disfluencies based on Conditional Random Fields was developed.

The second axis concerns the human-machine comparison on different tasks in relation with automatic speech processing. In order to gain insight into the impact of automatic speech transcription errors on further processing, a perceptual experiment was conducted on the human assessment of the severity of ASR errors. The experiment revealed the difficulty of such a task for the human annotators (i.e. classifying the error seriousness) and pointed out that the characteristics of the error region have an impact on the classification task. This experiment was been conducted within the VERA project. In the framework of the same project and with the objective of developing new metrics to evaluate post-ASR tasks such as Named Entity Detection, we are currently working on evaluating the impact of automatic speech recognition errors on correct Named Entity detection by humans.

The third axis is dedicated to the analysis of accents and speaking styles. The sociolinguistic literature differentiates three types of variation in speech: diatopic (regional), diastratic (social) and diaphasic ("stylistic", within-speaker). This complex reality is routinely referred to in layman's terms as accents and speaking styles. Our work combines perceptual and acoustic approaches to account for variation due to speakers' geographic and linguistic backgrounds (accents) as well as the communicative situation (styles). It is based on large amounts of data, using measurement tools derived from automatic speech processing techniques to quantify certain trends. The evolution of non-standard variants in French broadcast news data was studied in collaboration with M. Candea (Université Sorbonne Nouvelle, sabbatical leave). Regional and foreign accents in Italian were studied by two Italian PhD students: I. Margherita (Univ. Pisa) and M. Vitale (Univ. Naples "L'Orientale"). Another aspect concerns the modeling, identification and characterization of regional and foreign accents in French. Perceptual experiments and acoustic analyses were carried out using automatic phoneme alignments, which allowed for pronunciation variants corresponding to Southern, Belgian, West-African, Maghrebi, English, German, Spanish and Portuguese accents, among others. In total, over 100 hours of regional- or foreign-accented French were analyzed. Some of the most discriminating pronunciation features, such as the realization of nasal vowels in Southern French or the realization of certain schwas (backed and closed) in Portuguese-accented French were ranked using automatic learning techniques. Word-initial stress followed by a falling pitch contour was also evidenced in Senegalese-accented French and interpreted as a possible prosodic transfer from Wolof (the dominant language in Senegal) to French. Since speech conveys both phonemic and prosodic information, the contribution of prosody to the perception of regional or foreign accents (Belgian, Corsican, Italian, Polish, among others), the so-called banlieue accent and broadcasters' style was examined. The latter was studied from a diachronic perspective through newscast archives dating back to the 1940s. The methodology included prosody transplantation and modification/resynthesis. The contribution of prosody was highlighted especially for Belgian French, with peculiar vowel lengthening phenomena, Polish-accented French, with more word segmentation, the banlieue accent, with sharp word-final pitch falls, and the news announcer style of the 40s and 50s, with a more marked tendency to initial stress than in the following decades. Also, falling yes/no

questions were found in Corsican and in French in contact with Corsican; falling-rising (rising-rising, respectively) paroxytone-final yes/no questions were found in Catalan (Occitan, respectively) and French in contact with Catalan (Occitan, respectively): they may be attributed to prosodic transfer.

Topic 4: Robust analysis of spoken language and dialog systems

Sophie Rosset, Gilles Adda, Martine Adda-Decker, Mohamed Ben Jannet, Eric Bilinski, Camille Dutrey, Nicolas Foucault, Lori Lamel, Loïc Lahondes, Vincent Letard, Joseph Mariani, Ioana Vasilescu

This research topic addresses the analysis of spoken and written language for open domain interactive information retrieval. Spoken documents are complicated to process in part due to the nature of spoken language which includes phenomenas such as repairs, false starts, hesitations etc, and also may be subject to errors introduced by automatic transcription.

These last two years, we worked mainly on disluencies detection in spontaneous speech data. Our work is based on a CRF model using as features acoustic parameters along with linguistic and discursive ones (PhD work of C. Dutrey). This work concerns both this topic and Topic 3 (Perception and automatic processing of variation in speech) and has been done in collaboration with EDF and LPP (CNRS & Université Sorbonne Nouvelle).

Pursuing our work on Named Entity (NE) detection in automatically transcribed spoken data, we investigated three main research axes: (1) we developed for the REPERE challenge (see Topic 1) an ensemble approach based on multiple classifiers having different specific tasks (for example recognition of the word preceding or following the mention of a person, detection of a first name or last name etc.) and applying a final voter-based on a MaxEnt classifier. This approach obtained the best results in this specific sub-task (detecting person mention within speech) in the REPERE challenge. Moreover, it has been shown to obtain the best results for all ASR outputs used. We are now developing approaches based on neural networks, in order to allow the use of complex features (multiple hypothesis generated by an ASR system) and continuous features (for example acoustic parameters), (2) Knowing the ASR error types may also be of help for the NE system, but being able to model them is a real challenge. Within the VERA project, we also worked on studying the human evaluation of error seriousness and on the lexical and morpho-syntactic typology of error and the error context (in coordination with Topics 3 and 6). (3) In parallel with this activity, we are pursuing our work on developing new metrics to evaluate ASR in the context of follow-up tasks, such as Named Entity Detection. A new metric, based on the probability difference of having a label was developed and offers a better correlation with SER or ETER than the Word Error Rate. This work is done in collaboration with the Laboratoire national de métrologie et d'essais (LNE) and the LPP through a CIFRE doctorate (M. Ben Jannet, PhD student) and within the framework of the VERA project.

Moreover, pursuing our work on question answering within multimodal sources, we are now involved (with B. Grau from ILES group) in a collaboration with the IMM project from the IRT SystemX on Knowledge Base Population and confidence estimation. In this area, we are specifically interested in modeling the reliability of a new information.

Our research on spoken language dialog systems mainly concerns open domain interactive search and intelligent assistants. Our main scientific interest is on dialog management and more specifically, managing dialog context and history from a semantic point of view. Our model is based on the use of semantically motivated clusters and we developed a three-step algorithm which manages explicit and implicit user and system confirmations. We are now working in three different directions. The first aims to develop a cognitive assistant, which involves developing a multi-task model for dialog management. A

first version of the multi-task dialogue management model has been implemented, and demonstrated within Compagnon Numérique, a Futur En Seine project (Cap Digital and Région Ile de France). The second one aims at developing a system able to learn to model a domain and a task via natural language interaction (V. Letard, PhD). The last one aims at modeling a semantically aware social communication system, and is done within the framework of the Chist-Era project JOKER led by L. Devillers (see topic 2, Affective and social dimensions of spoken interactions).

Topic 5: Translation and machine learning

François Yvon, Gilles Adda, Alexandre Allauzen, Marianna Apidianaki, Hélène Bonneau-Maynard, Souhir Gahbiche-Braham, Marco Dinarelli, Khanh Quoc Do, Julia Ive, Li Gong, Linlin Li, Elena Knyazeva, Anil Kumar Singh, Thomas Lavergne, Aurélien Max, Jan Niehues, Nicolas Pécheux, Natalia Segal, Artem Sokolov, Guillaume Wisniewski, Yong Xu

Our research activities in this theme are focused on developing, testing, adapting and specializing proven and sound Machine Learning (ML) algorithms to the peculiarities of Natural Language and Speech Processing data. Our main testbed is a final application, Machine Translation for both speech and text input, which implies many intermediate sub-tasks (eg. part-of-speech (POS) tagging, syntactic analysis, named-entity recognition (NER), etc) that can also be approached with ML tools. Besides their intrinsic complexity, these problems imply to deal with (i) very large and (ii) heterogeneous datasets, containing both (iii) annotated and non-annotated data; further, linguistic data is often (iv) structured and can be described by (v) myriads of linguistic features, involving (vi) complex statistical dependencies. In addition to these scientific challenges, improving the current state-of-the-art in Machine Translation remains a major objectives; thus the need to develop and maintain our own MT software(s).

Statistical Machine Translation (SMT)

Statistical Machine Translation systems rely on the analysis of large parallel bilingual corpora to train stochastic models describing the mapping between a source and a target language. In their simplest form, these models express probabilistic associations between source and target words strings, as initially formulated in the IBM models. More recently, these models have been extended to richer representations (eg. chunks, trees, or dependency structures) and to probabilistic mappings between these representations. Our own research activities cover the entire spectrum of MT system development, from the design of word and phrase alignment models, to the conception of novel translation, reordering or language models; from the exploration of new training or tuning methodologies to the development of new decoding strategies. All these innovations need to be properly evaluated and diagnosed and significant efforts are devoted to the vexing issue of quality measurements and confidence estimation of MT outputs.

An important achievement has been the development of a complete software architecture for performing on-the-fly alignment and training for large-scale MT. This architecture allows us to study the benefits of source-rich, context-dependent translation models or to investigate incremental training regimes in conjunction with post-edition or pre-edition techniques; it also constitutes an extremely valuable plateform for demonstrating and teaching Machine Translation.

A substantial effort has also been devoted to study and develop linguistic annotation tools for bilingual reading applications - if the context is somewhat derivatives with respect to our long term objectives, it provides a nice use case to revisit and redefine old tasks that are crucial for MT such as alignment or word sense disambiguation.

During the period, we have finally continued to take an active part in international MT evaluation campaigns: in addition to our yearly participation to the WMT evaluation series (both the MT track and the Confidence Estimation Track), we have also invested a significant effort in the development of a complete speech translation pipeline (in collaboration with Topic 6) in the context of the IWSLT 2014 workshop.

Machine Learning

LIMSI's activities in the area of Machine Learning (ML) aim to bridge a gap between Machine Translation and Machine Learning: on the one hand, MT is a difficult application which provides us with a realistic testbed for many ML innovations. Conversely, it appears that the development of efficient, large-scale MT systems raise challenges the solutions of which can also be used in other contexts or give rise to generic solutions.

During the period, we have continued to develop training methodologies for very large scale neural networks for language and translation modeling, in the context of several national and international collaborations. Our main accomplishments are the study of various adaptive training strategies; of fast adaptation techniques and, more recently, of a novel training criterium (noise contrastive estimation) that should considerably speed up training and inference and enable a streamlined integration within the decoder.

A second contribution has been the continued study of machine learning architectures for structured prediction: most notably extensions of CRFs and reinforcement learning strategies in the presence of hidden derivation variables, with applications to chunking, dependency parsing, or grapheme-phoneme conversion.

A new thread of exploration in multilingual NLP has been the development of novel methodologies for performing cross-lingual transfert of linguistic knowledge, a situation where interesting ML problems such as learning with partial, ambiguous, and/or noisy labels occur almost naturally. These developments bridge a gap with other on-going work on the unsupervised inference of semantic representations from multilingual corpus and resources.

Topic 6: Speech recognition

Lori Lamel, Gilles Adda, Martine Adda-Decker, Cong-Thanh Do, Thiago Fraga Da Silva, Jean-Luc Gauvain, Gregory Gelly, William Hartmann, Panagiota Karanasou, Antoine Laurent, Rasa Lileikyte, Abdel Messaoudi, Anindya Roy

Speech recognition is concerned with converting the speech waveform, an acoustic signal, into a sequence of words. Today's most performant approaches are based on a statistical modelization of the speech signal. Our research addresses the main aspects of state-of-the-art speech recognizers: language modeling (cf Topic 5), lexical representation, acoustic-phonetic modeling and decoding. The realization of any individual word is highly dependent on the individual speaker, the social context and the acoustic environment (cf Topic 2). Automatic speech-to-text systems must be able to handle such time-varying contextual effects and be able to evolve over time to handle changes in style and topic, by adapt its vocabulary. Research on speech recognition is carried out in a multilingual context, investigating and developing models for a variety of languages and variants. In collaboration with Topic 3, system errors are studied to identify potential technological weaknesses and are compared with human performance baselines.

One of the recent trends in speech-to-text systems is using discriminative techniques with large corpora to build more accurate models. The discriminative property can be included in the feature extraction by using discriminative classifiers such as multi-layer perceptrons (MLPs). By covering a wide temporal context MLP features can potentially capture different speech properties than the widely used short-term cepstral features. In addition, MLPs can be trained to deliver estimates of class posteriors which can be used as features for Gaussian mixture acoustic models. Training an MLP on large corpora requires efficient algorithms to remain computationally manageable. One of the important properties of MLP features is their complementarity with short-term cepstral features. Research has addressed how to best include both feature types in a transcription system.

In the context of the Quaero program various approaches for unsupervised training were studied extending previous work on semi-supervised and unsupervised acoustic model training for broadcast and web data for which supervision can be provided via language models trained on webtests. In the context of the iARPA Babel program, as a member of the Babelon team led by BBN, we are addressing speech recognition and spoken term detection for low resourced languages. We have been exploring the automatic discovery of acoustic and lexical units for speech recognition and multilingual acoustic modeling. For conversational telephone speech, and in particular for low resourced languages, it is much more difficult to locate representative speech data with related texts than was the case in Quaero. For such tasks, most of todays speech transcription systems are trained, or at least bootstrapped, with manually transcribed data. Therefore a highly relevant issue is the selection of speech data that should be manually transcribed. Our recent work in Babel, is investigating active learning for training data selection. Other ongoing work is exploring how to develop multilingual probabilistic features and on how to best adapt them across tasks, variants and languages. This research will be extended in the ANR Salsa project (started Fall 2014) addressing speech recognition and spoken term detection for casual and accented French speech.

A closely related research topic is language recognition, including language identification (that is identifying the language and/or dialect of an audio document) and language detection. A parallel phonotactic approach was investigated for varied data types (broadcast, web, and telephone speech) within the context of the Quaero program and is now being applied to Arabic dialects in the DGA RAPID ORELO project.

Speech recognition is a core technology for processing of audio and audiovisual documents. For such applications, the speech-to-text output must meet two needs: a representation that is easily searchable by machine and a representation that can be easily read by humans. We supported the MediaEval and TrecVID 2013-2014 evaluations by providing automatic transcripts for several hundreds of hours of audio data. Thousands of hours of audiovisual archives have been transcribed as part of the Equipex Matrice project [1] aiming to preserve and make collective memory more accessible. In the context of the IWSLT 2014 workshop and in collaboration with Topic 5 (Machine Translation), we developed the speech recognition component of the complete speech translation system for English TED lectures.

Topic 7: Language resources

Gilles Adda, Eric Bilinski, Hervé Bredin, Jean-Jacques Gangolf, Jean-Luc Gauvain, Lori Lamel, Joseph Mariani, Sophie Rosset, Rita Sidabraite-Brunet, Anh-Phuong Ta

Statistical models and comparative evaluation have been a driving force in speech processing for over 30 years. Corpora are central to these two major paradigms. While in the past, the use of large corpora has been limited to a few domains and languages, the last decade has witnessed a real expansion towards multilinguality and multimodality. Developing corpora and organizing evaluations are crucial for the

language community, and in turn pose scientific problems which need to be solved, such as what corpora to collect and how they should be annotated, as well as scientific questions on how to reward their promoters and how to ensure the ethics in the collection process. This topic deals with theoretical and practical problems concerning the collection, annotation and diffusion of large multilingual corpora.

Specific problems usually lead to specific corpora. The evaluation of methods to deals with out-of-vocabulary words (OOV) in ASR is an example: classical corpora contain a very small number of OOV (typically less than 1%) which makes the use of WER inappropriate to compare methods; therefore for the Edylex project a specific corpus of 20h of French and English broadcast news was selected containing a high proportion (>4%) of OOVs. Error classification, diagnosis and impact measurement via perceptive tests constitute important steps in identifying weaknesses in the models of state-of-the-art transcription systems and preparing for future generations of spoken language processing systems. We address this important matter in close coordination with other topics of the group, Topic 3 (perception), 4 (robust analysis), and 6 (speech recognition). In this topic the focus is on the problem of multilevel annotation of errors in speech corpora. In collaboration with the ILES group, an extended definition for Named Entities was proposed. Following these guidelines, two different corpora, one from contemporary broadcast news and the other from old OCRized newspaper have been annotated, each one containing about 1.5 million of words. Because human annotation is an interpretation process, there is no "truth" to rely on. It is therefore impossible to really evaluate the validity of an annotation. A study of the inter-annotator agreement (IAA) allowed validation of the overall quality of the two corpora, which were made available to the research community. As part of the Quaero programme, 35 transcribers were hired on fixed-term contracts in order to annotate large multilingual corpora: over 1,700 hours of varied broadcast audio data as well as seminars were manually transcribed. This work concerned 25 different languages of which some are low e-resourced. These data contributed to the development of automatic speech recognition systems and to the improvement of speaker diarization, with a portion reserved for the annual evaluations. For the acquisition of oral data, a podcast recording platform was set up which assures the daily recovery of audio files to be transcribed, renames them, and normalizes the signal. After manual transcription, the orthography was verified using automatic correction. For some purposes, such as person recognition in broadcast news shows, semantic information is found not only in the speech, but from all different modalities present in the media. In this context, we are developing collaborative tools and guidelines to annotate multilingual, multimodal, multimedia data (Chist-era Camomile project).

In addition to our activities in corpus production, more general investigations on Language Resources (LR) are conducted in connection with the FLaReNet and META-NET European Networks. They address the compilation of LR mentioned in papers presented at conferences (LRE Map), the comparison of the status across languages (Language Matrices and Tables) and the detection of gaps for some languages (Less-Resourced Languages), the unique identification of a LR and the computation of its impact factor. It also concerns the ethical dimension of LR production and distribution in the context of an increase of interest internationally for Data Sharing and Crowdsourcing. After some preliminary studies concerning the ethical and legal issues of the use of Crowdsourcing for Language Resource production, we have developed in collaboration with Aproged, Cap Digital, AFCP and ATALA a charter of good practice "Ethics and Big Data".

Highlights

- Best results in REPERE challenge 2013 (main supervised and unsupervised tasks).
- Participations in the iARPA Babel/NIST Open Keyword Search evaluations 2013 and 2014.
- Report n°1 CERNA- ALLISTENE "Ethics of the research in robotics".
- Lori Lamel keynote at InterSpeech'2014 on "Language diversity: speech processing in a multi-lingual context".
- Video ARTE "emotion detection : application in robotics" in 2014.

Staff

Permanent staff

Last name	First name	Position	Employer	HDR	Arrived	Left
Adda	Gilles	IRHC	CNRS	HDR		
Allauzen	Alexandre	MC	Université Paris-Sud	HDR		
Apidianaki	Marianna	CR2	CNRS			
Barras	Claude	MC	Université Paris-Sud	HDR		
Bilinski	Eric	IE1C	CNRS			
Boula De Mareüil	Philippe	CR1	CNRS	HDR		
Bredin	Hervé	CR1	CNRS			
Devillers	Laurence	PR2	Université Paris Sorbonne	HDR		
Gangolf	Jean-Jacques	IR1	CNRS			23/08/2014
Gauvain	Jean-Luc	DR1	CNRS	HDR		
Guinaudeau	Camille	MC	Université Paris-Sud		01/09/2013	
Lamel	Lori	DR1	CNRS	HDR		
Mariani	Joseph-Jean	DRCE	CNRS	HDR		
Maynard	Hélène	MCHC	Université Paris-Sud	HDR		
Rosset	Sophie	DR2	CNRS	HDR		
Vasilescu	Ioana	CR1	CNRS			
Wisniewski	Guillaume	MC	Université Paris-Sud			
Yvon	François	DR1	Université Paris-Sud	HDR		

PhD Students

Last name	First name	Arrived	Thesis defense	Ecole Doctorale	School / University
Béchade	Lucile	01/10/2014		EDIPS	Université Paris-Sud
Ben Jannet	Mohamed	15/10/2012		EDIPS	Université Paris-Sud
Bluche	Théodore	01/10/2011		EDIPS	Université Paris-Sud
Chastagnol	Clément	01/01/2010	04/10/2013	EDIPS	Université Paris-Sud
Delaborde	Agnès	04/09/2009	19/12/2013	EDIPS	Université Paris-Sud
Do	Quoc Khanh	01/10/2012		EDIPS	Université Paris-Sud

Last name	First name	Arrived	Thesis defense	Ecole Doctorale	School / University
Dutrey	Camille	06/12/2011		EDIPS	Université Paris-Sud
Foucault	Nicolas	01/10/2009	16/12/2013	EDIPS	Université Paris-Sud
Fraga Da Silva	Thiago Henrique	01/07/2009	29/09/2014	EDIPS	Université Paris-Sud
Gahbiche-Braham	Souhir	01/11/2009	30/09/2013	EDIPS	Université Paris-Sud
Gelly	Gregory	02/05/2014		EDIPS	Université Paris-Sud
Gong	Li	01/10/2011	25/11/2014	EDIPS	Université Paris-Sud
Ive	Julia	20/02/2014		EDIPS	Université Paris-Sud
Karanasou	Panagiota	01/09/2009	11/06/2013	EDIPS	Université Paris-Sud
Knyazeva	Elena	01/10/2013		EDIPS	Université Paris-Sud
Labeau	Matthieu	01/10/2014		EDIPS	Université Paris-Sud
Letard	Vincent	01/10/2013		EDIPS	Université Paris-Sud
Loser	Kevin	01/10/2014		EDIPS	Université Paris-Sud
Pécheux	Nicolas	01/10/2012		EDIPS	Université Paris-Sud
Soury	Mariette	01/10/2011	28/10/2014	EDIPS	Université Paris-Sud
Xu	Yong	01/10/2012		EDIPS	Université Paris-Sud
Yang	Fan	01/10/2012		EDIPS	Université Paris-Sud

Non permanent staff

Last name	First name	Position	Employer	Arrived	Left
Albert	Pierre	IR	CNRS	01/02/2013	13/06/2013
Amazouz	Djegdjiga	CDD IE	CNRS	01/11/2014	30/04/2015
Chastagnol	Clément	CDD IE	CNRS	01/02/2013	31/05/2013
Chastagnol	Clément	CDD IE	CNRS	01/06/2013	30/11/2013
Cui	Xiangli	CDD IE	CNRS	01/02/2014	31/05/2014
Doukhan	David	CDD Chercheur	CNRS	01/10/2013	30/09/2014
Dubuisson-Duplessis	Guillaume	CDD Post-Doc	CNRS	01/10/2014	30/09/2015
Fraga Da Silva	Thiago Henrique	ATER	Université Paris-Sud	01/09/2013	31/08/2014
Gahbiche-Braham	Souhir	ATER	Université Paris-Sud	01/09/2013	31/07/2014
Gossart	Clément	CDD IE	CNRS	01/10/2014	30/06/2015
Hartmann	William	CDD	CNRS	01/10/2013	31/12/2013
Hartmann	William	CDD	CNRS	01/01/2014	31/05/2014
Hartmann	William	CDD	CNRS	01/06/2014	30/09/2014
Hellec	Charline	IE	CNRS	15/09/2014	31/12/2014
Jarry	Lola	IE	CNRS	15/09/2014	31/12/2014
Lauly	Stanislas	Bourse Pays d'origine	Université de Sherbrooke	27/10/2014	05/12/2014
Laurent	Antoine	CDD IR	CNRS	01/10/2013	31/05/2014
Laurent	Antoine	CDD IR	CNRS	01/06/2014	31/10/2014
Lencina	Julieta	IE	CNRS	11/08/2014	31/10/2014
Li	Linlin	PostDoc	CNRS	05/03/2014	04/03/2015
Lileikyté	Rasa	CDD Chercheur	CNRS	01/11/2014	31/10/2015
Lysaght	Ruth	CDD IE	CNRS	01/01/2013	30/04/2013

Messaoudi	Abdelkhalek	Chercheur	CNRS	01/04/2013	31/12/2013
Nguyen	Huyen Anh	CDD Chercheur	CNRS	01/02/2014	31/05/2014
Niehues	Jan	CDD Chercheur	CNRS	01/02/2014	31/03/2014
Poignant	Johann	CDD Post-Doc	CNRS	01/09/2014	29/02/2016
Rezgui	Abdelhakim	CDD IR	CNRS	15/10/2014	31/12/2014
Roy	Anindya	CDD	CNRS	01/06/2013	31/03/2014
Sarkar	Achintya Kumar	PostDoc	CNRS	01/07/2013	30/04/2014
Segal	Natalia	CDD Chercheur	CNRS	01/01/2014	31/12/2014
Sehili	Mohamed El Amine	CDD	CNRS	01/10/2013	30/09/2014
Sehili	Mohamed El Amine	CDD	CNRS	01/10/2014	30/09/2015
Sidabraite-Brunet	Rita	IE	CNRS	01/06/2013	31/12/2013
Strucl Rojko	Mirjam	CDD IE	CNRS	01/01/2013	31/03/2013
Ta	Anh-Phuong	Chercheur	CNRS	01/12/2013	31/03/2014
Tahiri	Hicham	CDD IR	CNRS	01/05/2013	31/05/2013
Tahon	Marie	Chercheur	CNRS	01/09/2014	31/08/2015
Tamura	Satoshi	Professeur invité	Digiteo	16/09/2013	06/12/2013
Vieira	Lilian	IE	CNRS	01/09/2013	30/09/2013
Vitale	Marilisa	Bourse Erasmus	NULL	08/04/2013	30/06/2013

Internships

Last name	First name	Arrived	Left	Prepared degree	School / University
Albalat	Arnaud	14/10/2013	31/01/2014	Ingénieur	Ecole Polytechnique
Aufrant	Lauriane	01/07/2014	16/12/2014	Ingénieur	ParisTech
Béchade	Lucile	01/04/2014	31/08/2014	M2 Ingénierie Linguistique	Université Paris Sorbonne
Birski	Anouk	01/07/2014	31/07/2014		Université Paris-Sorbonne
Cabaco	Adrien	15/04/2013	05/07/2013	DUT informatique	Université Paris-Sud
de Laboulaye	Guillaume	14/10/2013	31/01/2014	Ingénieur	Ecole Polytechnique
Doumbia	Mamadou	01/04/2014	31/08/2014	M2 TSSI	UPMC
Duvernoy	Basil	01/01/2013	24/05/2013		
Godard	Pierre	01/04/2014	30/09/2014	Master 2	Université Paris Sorbonne
Goryainova	Maria	01/06/2013	31/08/2013	M2 ingénierie multilingue	INALCO
Gossart	Clément	22/04/2014	21/09/2014	Ingénieur	ESME Sudria
Gossart	Clément	01/06/2013	31/08/2013	Ingénieur	ESME Sudria
Himri	Mohamed Nabil	01/06/2013	31/07/2013	PeiP	Polytech Paris-Sud
Ivent	Fanny	01/03/2013	31/07/2013	M2 Sciences du langage	Université Sorbonne Nouvelle
Jean-Marie	Oana	01/05/2014	18/09/2014	Master 2	Université Paris Descartes
Knyazeva	Elena	02/04/2013	30/09/2013	Ingénieur	Télécom Paristech
Labeau	Matthieu	07/04/2014	18/09/2014	Master	ENS Cachan
Laveau	Marie	15/01/2014	16/05/2014	Master Informatique	Université Paris-Sud
Letard	Vincent	02/04/2013	15/09/2013	M2 IAD	UPMC

Last name	First name	Arrived	Left	Prepared degree	School / University
Lyet	Thomas	01/06/2013	31/08/2013	Ingénieur	Polytech Paris-Sud
Qin	Ze	15/01/2014	16/05/2014	M Informatique	Université Paris-Sud
Richard	Pierre	01/01/2013	24/05/2013		
Sediri	Arij	01/04/2014	31/08/2014	Master 2	Université Sorbonne Nouvelle
Verzeni	Emilia	10/06/2013	10/09/2013	Master 1	Université Paris Diderot
Wang	Xin	15/05/2013	31/08/2013	M1 Informatique	Université Paris-Sud
Zhu	Xuan	01/06/2013	30/09/2013	M2 IAC	Université Paris-Sud

Indicators of scientific notoriety

Scientific events

- G. Adda, P. Boula de Mareüil Program Committee of XXXe Journées d'Etude sur la Parole (JEP 2014), Le Mans, June 23-27 2014.
- G. Adda (General chair), J. Mariani (Co-Chair), C. Barras, H. Bredin, S. Rosset, F. Yvon, G. Wisniewski members of the Organizational Committee of the ERRARE Workshop (Ermenonville, 21-22 November, 2013)
- A. Allauzen, Co-organizer of two ACL Workshops on "Continuous Vector Space Models and their Compositionality" (Sofia, Bulgaria, August 9 2013 ; Gothenburg, Sweden, April 27 2014)
- C. Barras, Area Chair (Speaker Characterization, Speaker and Language Recognition), Interspeech 2013.
- H. Bredin, Organizing committee, First Workshop on Speech, Language and Audio in Multimedia, SLAM 2013, Marseille, August 22-23, 2013
- L. Devillers, Co-organizer of the 5th international Workshop on EMOTION, SOCIAL SIGNALS, SENTIMENT & LINKED OPEN DATA"" (Reykjavik, Iceland, May 26, 2014)
- L. Devillers, Co-organizer of the special events Interspeech 2013: Show and Tell sessions and roundtable, Lyon, August 25-29, 2013
- L. Lamel, Technical Chair and member of Steering Committee, Interspeech 2013, Lyon, August 25-29, 2013
- L. Lamel, Area Chair (LVCSR and Its Applications, Technologies and Systems for New Applications) Technical Program Committee, Interspeech 2014, Singapore, September 14-18, 2014
- L. Lamel, 2nd International Conference on Statistical Language and Speech Processing, Program Committee, Grenoble, October 14-16, 2014.
- J. Mariani, Member of the Program Committee of the TRALOGY'2013 Conference (Paris, January 17-18 2013) and TRALOGY'2015 Conference (Strasbourg, 2015)
- J. Mariani, Member of the Technical Program Committee of the Speech Processing Conference (Tel Aviv, Israel) 2013 (July 1-2, 2013) & 2014 (July 7-8, 2014)
- J. Mariani, Member of the organization committee (in charge of the coordination of the Prospective) of Interspeech 2013 (Lyon, August 25-29, 2013)
- J. Mariani, Member of the Program Committee of the IJCNLP'13 conference (Nagoya, Japan, October 14-18, 2013)
- J. Mariani, Member of the International Advisory Committee of Oriental Cocosda 2013 (Gurgaon, India, November 25-27, 2013) and 2014 (Phuket, Thailand, September 10-12, 2014)

- J. Mariani, Co-chair of the International Workshop on Spoken Language Translation (IWSLT'13) (Heidelberg, Germany, December 5-6, 2013)
- J. Mariani, Member of the Scientific Committee of the "Language and Technology Conference" (L&TC'2013) (Poznan, Poland, December 7-9, 2013)
- J. Mariani, Co-chair of the "Which Resources for Minority Languages, and How ? Towards an Agenda for LRTs for Minority Languages" Workshop at the "Language and Technology Conference" (L&TC'2013) (Poznan, Poland, December 8, 2013)
- J. Mariani, Member of the Steering Committee of the "International Workshop on Spoken Dialog Systems" IWSDS'2014 (Napa Valley, USA, January 18-20, 2014) and IWSDS'2015 (Busan, Korea, January 12-13, 2015)
- J. Mariani, Member of the Program Committee of the CREIS-TERMINAL Conference (Nantes, 3-4 April, 2014)
- J. Mariani, Member of the Program Committee of the Workshop "Collaboration and Computing for Under-Resourced Languages in the Linked Open Data Era" (Reykjavik, Iceland, May 26, 2014)
- J. Mariani, Member of the Scientific Committee of the Workshop on Indian Language Data: Resources and Evaluation (WILDRE) (Reykjavik, Iceland, May 27, 2014)
- J. Mariani, Member of the Program Committee of the Language Resources and Evaluation Conference LREC'14 (Reykjavik, Iceland, May 28-30, 2014)
- J. Mariani, Member of the Program Committee of the "Language Technology Service Platforms: Synergies, Standards, Sharing" (Reyjavik, Iceland, May 31, 2014)
- J. Mariani, Member of the Scientific Committee of the ACL'2014 Conference (Baltimore, USA, June 22-27, 2014)
- J. Mariani, Member of the Organization Committee of the ETHICOMP and CEPE 2014 Conferences (Paris, June 23-27, 2014)
- J. Mariani, Member of the Scientific Committee of the ATALA "Ethique et TAL" Workshop (Paris, November 22, 2014)
- J. Mariani, F. Yvon, Members of the Steering Committee of the "International Workshop on Spoken Language Translation" IWSLT'2014 (Lake Tahoe, USA, December 4-5, 2014)
- F. Yvon, PC Chair, "International Workshop on Spoken Language Translation" IWSLT'2014 (Lake Tahoe, USA, December 4-5, 2014)

Editorial activities

- G. Adda, Member of the Drafting Committee of the "Ethics and Big Data" Charter (2012-2013)
- L. Devillers, Co-editor of the Book "Natural Interaction with Robots, Knowbots and Smartphones" Springer (2013)
- L. Devillers, Member of the group of the CERNA - Allistene on "Ethics of research in robotics",Report n°1 of the CERNA (2014)
- J.L. Gauvain Speech Communication Editorial Board Member
- J.L. Gauvain Scientific Advisory Board of Annals of Telecommunications
- L. Lamel Speech Communication Editorial Board Member
- L. Lamel Editorial Board of the Journal of Natural Language Engineering (since Jan 2012)
- L. Lamel Advisory Board member of John Benjamin's book series in Natural Language Processing
- J. Mariani, Editorial Board member of the International Journal of Speech Technology (Springer) (1994–)

- J. Mariani, Editorial Board member of the "Text, Speech and Language Technology" book series (Springer) (1995–)
- J. Mariani, Editorial Board member of the "Language Resources and Evaluation" Journal (Springer) (2004–)
- J. Mariani, Member of the Scientific Committee of the ISTE-Wiley “Cognitive Science and Knowledge Management” Book series (2013-)
- J. Mariani, Co-editor of the Book "Natural Interaction with Robots, Knowbots and Smartphones" Springer (2013)
- J. Mariani, Co-editor of the e-Book "Translation Careers and Technologies: Convergence Points for the Future”, Tralogy II Proceedings (2013)
- J. Mariani, Co-editor of the Book "Human Language Technology Challenges for for Computer Sciences and Linguistics", Springer LNAI (2014)
- J. Mariani, Reviewer of the Book "Dialog Systems and Intelligent Assistants", Springer (2014)
- J. Mariani, Member of the Editorial Committee of the “Ethics and Big Data” Charter (2012-2013)
- J. Mariani, Member of the Editorial Committee, UNESCO IFAP Yakutsk Declaration on Linguistic and Cultural Diversity in Cyberspace (2014)
- S. Rosset, Co-editor of the Book "Natural Interaction with Robots, Knowbots and Smartphones" Springer (2013)
- S. Rosset, Member of the Editorial Board of Traitement Automatique des Langues (since nov. 2014)
- F. Yvon, Member of the Editorial Board of Traitement Automatique des Langues (since sept. 2005)

Invited lectures, talks or seminars

- G. Adda, L’apport de l’expertise scientifique au développement de ressources et à l'évaluation en traitement des données multimédias, Séminaire DGA Traitement de l’information multimédia et fusion d’information (TIM 2014), Paris, France, 01/07 au 02/07, 2014
- A. Allauzen, Apprendre des représentations continues/distribuées de mots et de documents, Journée commune AFIA-ATALA sur "Langue, apprentissage automatique et fouille de données", Paris, 22nd march 2014
- A. Allauzen, Statistical approaches for Machine Translation, Atelier corpus multilingues, JADT, Paris, june 2014
- M. Apidianaki, Lexical ambiguity in Machine Translation, Invited talk, Tralogy, Paris, January 2013.
- M. Apidianaki, La place de la sémantique dans la Traduction Automatique, Séminaire à l'Université de Mulhouse, Cycle de rencontres sur la traduction, novembre 2013.
- L. Devillers, talk in Natural Interaction with Social Robots Workshop, EuRobotics Forum, Rovereto, Italie, mars 2014
- L. Devillers, invited talk in Bridge Meeting: Geneva Minimalistic Feature Set Recommendation, Geneva, Suisse, septembre 2013
- L. Devillers, invited to the Dagstuhl Seminar 13451, "Computational Audio Analysis", november 2013
- J.L. Gauvain, Speech Transcription and Keyword Spotting with Limited Linguistic Resources (Transcription de la parole et détection de mots-clés avec des ressources linguistiques limitées) DGA Traitement de l'Information Multimédia (TIM), July 2014
- L. Lamel, keynote: Unsupervised Acoustic Model Training with Limited Linguistic Resources, ASRU 2013, Dec 8-12, 2013 Olomouc, Czech Republic
- L. Lamel, keynote: Language diversity: speech processing in a multi-lingual context, Interspeech 2014, Singapore September 16, 2014
- J. Mariani, P. Paroubek, G. Francopoulo, M. Deleborde, Rediscovering 25 years of discoveries, Interspeech’2013, Lyon, August 26-29, 2013

- J. Mariani, Language Technologies in support of Multilingualism, Unity in Diversity: Languages for Mobility, Jobs and Active Citizenship Conference, Vilnius (Lithuania), September 25-26, 2013
- J. Mariani, ICT Enabling Language Diversity, Symposium National Languages in Higher Education and Science, Athens (Greece), November 7, 2013
- J. Mariani, P. Paroubek, G. Francopoulo, O. Hamon, Rediscovering 15 years of Discoveries in Language Resources and Evaluation, LREC'2014, Reykjavik (Iceland), May 28-30, 2014
- J. Mariani, Pour une éthique de la recherche en Sciences et Technologies de l'Information et de la Communication, Séminaire AGORANTIC, Avignon, June 11-12, 2014
- J. Mariani, Language Technologies in Support to Multilingualism, 3rd Conference on Linguistics and Cultural Diversity in Cyberspace, Yakutsk (Russia), June 29-July 1st, 2014
- S. Rosset, Accords inter-annotateurs dans une campagne d'annotation : de la théorie à la pratique, Séminaire ERSS, Toulouse, France, mars 2013.
- G. Wisniewski, Conception et analyse d'un corpus de post-éditions : estimation de qualité et analyse d'erreurs pour la traduction automatique, 4th Workshop on Translation Quality, Lille, janvier 2014
- F. Yvon, invited talk on "Statistical Learning in Natural Language Processing, a brief retrospective", IRISA, march 22nd 2013; also U. Montréal, june 25th, 2013
- F. Yvon, invited talk on "Méthodes Statistiques en Traitement des Langues, Etat des lieux et Perspectives", Journées TAL, Nancy, jan 15th 2013; also Journée d'Etude AFIA/ATALA, Paris, 25th march 2014.

Participation in expertise and administration of research

- C. Barras, Expert panel for ANR/CHIST-ERA AMCE projects, March 2014
- L. Devillers, Expertise of ANR Projects (2013)
- L. Devillers, Expert in the Commission Connaissances of Cap Digital (2011-)
- L. Devillers, Expert of NWO (Netherlands Organisation for Scientific Research) project (2014)
- L.Lamel, Expert reviewer for EC project Dirha, March 2014
- L. Lamel, Expert panel for ANR Chist-era D2K projects, March 2014
- J. Mariani, Member of the Allistene Ethics Committee (CERNA) (2012-)
- J. Mariani, Member of the "Anonymat dans la conception des Technologies Numériques" Working Group of CERNA (2013-)
- J. Mariani, Member of the International Advisory Committee of the MULTISAUND program (Turkey) (2010-2013)
- J. Mariani, Member of the evaluation committee of the CHIST-ERA Intelligent User Interfaces (IUI) program (2013)
- J. Mariani, Member of the Loebner Prize 2013 Production Crew (2013)
- J. Mariani, Member of the OSEO FUI Romeo2 project Societal Committee (2013-)
- J. Mariani, Member of the Interministerial Group on Translation (GIT) (2009-)
- J. Mariani, Representative of CNRS at the Institut pour la Société Numérique (ISN) Pilot Committee (2012-)
- J. Mariani, Member of the organization committee of the DGLFLF-Silicon Sentier “Nouvelles technologies, langue française et langues de France” BarCamps (2012-2013)
- J. Mariani, Member of the DGLFLF Pilot Committee of the “Language Resources for the languages of France” study (2012-2014)
- J. Mariani, Member of the Conseil d'orientation des politiques linguistiques dans les Outre-mer, DGLFLF (2013-)

- J. Mariani, Member of the UNESCO Expert Meeting "Improving Access to Multilingual Cyberspace", Paris, October 28-29, 2014
- S. Rosset, Expertise of ANR project (2013)
- S. Rosset, expert in the Commission Connaissances of Cap Digital (2011-)
- F. Yvon, Expertise of ANR Projects (2013, 2014)

Ph.D and Habilitation committees

- A. Allauzen (1 committee as director)
- C. Barras 2 commitees (1 as director)
- H. Bredin 1 committee as co-director
- L. Devillers 4 committees (1 as president, 3 as co-director)
- J.L. Gauvain 2 committees (1 as president,1 as co-director)
- L. Lamel 4 committes
- J. Mariani 1 committee (0,1,0,0)
- S. Rosset 6 committees (3,1,1,1)
- G. Wisniewski 1 committee (0, 0, 1, 0)
- F. Yvon 10 (3,6,1,2)

Position in Scientific Councils or Associations or Networks

- G. Adda, P. Boula de Mareuil, S. Rosset, L. Devillers are elected members of the AFCP Management Board (2013-2014)
- M. Apidianaki, Member of the SIGLEX (ACL Special Interest Group on the Lexicon) Executive Board (2013-2016)
- Ph. Boula de Mareuil, L. Devillers, S. Rosset, scientific comittee of the IRCOM (IR Copus Oraux et Multimodaux)
- L. Devillers is elected as Member of the AAAC (HUMAINE) Management Board (2013-2014)
- J. Mariani, Member of the Association Francophone pour la Communication parlée (AFCP) Advisory Committee (2001-)
- J. Mariani, Life Member of the ISCA (International Speech Communication Association) International Advisory Committee (2004-)
- J. Mariani, Member of the ISCA Fellowship Committee (2011-2014)
- J. Mariani, Honorary President of the European Language Resources Association (2010-)
- J. Mariani, Member of the Coordinating Committee on Speech Databases and Speech I/O Systems Assesment (Cocosda) International Advisory Committee (2002-)
- J. Mariani, Member of the CESIT–Corsica (Atlas des données toponymiques) Scientific Committee (2009-)
- J. Mariani, Member of the T4ME NoE Management Board (2010-2013)
- J. Mariani, Member of the META-NET Technological Council (2010-)
- J. Mariani, Member of the META-NET Executive Board (2011-)
- J. Mariani, Coordinator of the META–Net Interactive Systems Vision Group (2010-2013)
- J. Mariani, Member of the META–Net Media and Information Services Vision Group (2010-2013)
- J. Mariani, Member of the META–Net Translation and Localisation Vision Group (2010-2013)
- J. Mariani, Founding Member of the META-TRUST Association (2012-)
- J. Mariani, Member of the QTLaunchPad Planning Panel (2012-2014)
- J. Mariani, Member of the ROCKIT Roadmap Board (2012-)
- G. Wisniewski, Member of the Advisory Panel of IATIS 2015

- F. Yvon, Member of the Scientific Council of the Laboratoire d'Informatique de Paris-Nord
- F. Yvon, Member of the Coordinating Committee of DIGITEO (2013-)
- F. Yvon, Member of the Coordinating Committee of the Paris Saclay Center for Data Science (2014-)

Dissemination and scientific outreach

- S. Braham Gahbiche, Interview for the Magazine "La Recherche" special issue on Machine Translation (June 2013)
- L. Devillers, co-auteur de "Ethique de la recherche en robotique", report n°1, CERNA, Allistene (Novembre 2014)
- L. Devillers, Video ARTE "emotion detection : application in robotics" (2014).
- J.L. Gauvain, organisation and scientific chair of "Quaero - Journée de l'innovation" (March 2013).
- J.L. Gauvain, organisation of the Quaero session at Rencontres R&D Cap Digital (October 2013).
- L. Lamel, "Transcription de la parole et traduction", Quaero - Journée de l'innovation" (March 2013)
- L. Lamel, "Speech Processing", Rencontres R&D Cap Digital (October 2013)
- J. Mariani, 21 langues menacées d'extinction numérique, Journal du CNRS, n° 270 (Jan-Feb 2013) http://www.cnrs.fr/fr/pdf/jdc/270/index.html#/12/
- J. Mariani, Faciliter l'intercompréhension : une Europe libérée des barrières linguistiques, Press Release (February 2013)
- J. Mariani, L'extension du modèle Quaero au niveau Européen, Quaero White Paper (March 2013) http://immi-lists.limsi.fr/IMG/pdf/Livre-Blanc-Quaero-V3-final.pdf
- J. Mariani, Le Web sera-t-il polyglotte ? Interview for "La Recherche" magazine (Octobre 2013)
- S. Rosset, Futur En Seine, Démonstrateur Samy le Compagnon Numérique (June, 2013)

Research conventions and contracts

Starting date	Ending date	Acronym	Category	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/10/12	31/03/16	CAMOMILE	Collaboration de recherche	ANR	Barras Claude	Barras Claude	National	230 894	Chist-ERA
01/01/14	30/06/17	JOKER	Collaboration de recherche	ANR	Devillers Laurence	Devillers Laurence	National	266 369	Chist-ERA
01/10/14	30/09/16	MetaDaTV	Collaboration de recherche	ANR	Guinaudeau Camille	Guinaudeau Camille	National	48 980	Contenus, connaissances, interactions
01/01/13	31/12/15	DIADEMS	Collaboration de recherche	ANR	André-Obrecht Régine	Barras Claude	National	74 708	CONTINT
01/11/10	31/08/14	QCOMPERE	Collaboration de recherche	ANR	Barras Claude	Barras Claude	National	90 500	CONTINT
01/10/12	31/07/16	TransRead	Collaboration de recherche	ANR	Yvon François	Yvon François	National	236 222	CONTINT
22/02/11	31/12/19	MATRICE	Collaboration de recherche	ANR	Peschanski Denis	Gauvain Jean-Luc	National	180 000	Equipex
15/12/10	30/11/14	PADE	Collaboration de recherche	ANR	Rilliard Albert	Rilliard Albert	National	163 513	JCJC
01/10/14	31/03/19	RESTAURE	Collaboration de recherche	ANR	Delphine BERNHARD	Ligozat Anne-Laure	National	78 245	Prog non thématique

Starting date	Ending date	Acronym	Category	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/01/13	31/12/15	VERA	Collaboration de recherche	ANR	Estève Yannick	Rosset Sophie	National	75 810	Prog non thématique
01/10/14	30/09/17	SALSA	Collaboration de recherche	ANR	Vieru Bianca	Gauvain Jean-Luc	National	260 990	Réseaux, technologies logicielles, cybersécurité et Sécurité globale
18/03/13	31/12/16	SONAR	Collaboration de recherche	BPI	Gariel Jean-Baptiste	Paroubek Patrick	National		Pôle de compétitivité
01/03/14	29/02/16	ORELO	Collaboration de recherche	DGCIS	Fluhr Christian	Gauvain Jean-Luc	National	77 149	RAPID
03/03/14	02/03/17	PAPYRUS	Collaboration de recherche	DGCIS	Sennellard Jean	Yvon François	National	258 638	RAPID
01/06/12	31/05/14	RAPMAT	Collaboration de recherche	DGCIS	Courcinous Sandrine	Gauvain Jean-Luc	National	197 089	Pôle de compétitivité
01/04/08	31/12/13	QUAERO	Collaboration de recherche	OSEO	Gauvain Jean-Luc	Gauvain Jean-Luc	Européen	7 506 519	
01/12/12	30/11/16	ROMEO2	Collaboration de recherche	OSEO	Bessière Pierre	Devillers Laurence	National	293 308	Pôle de compétitivité
01/09/11	31/08/14	E-therapies	Collaboration de recherche	Région Ile de France	Devillers Laurence	Devillers Laurence	National	134 776	Pôle de compétitivité
01/04/14	31/12/14		Autre	CNRS	Devillers Laurence	Devillers Laurence	National	4 000	soutien préparation H2020
01/04/14	31/12/14		Autre	CNRS	Rosset Sophie	Rosset Sophie	National	3 000	soutien préparation H2020
06/12/11	05/12/14		Collaboration de recherche	EDF	Rosset Sophie	Rosset Sophie	Industriel	45 000	CIFRE
22/10/12	21/10/15		Collaboration de recherche	LNE	Rosset Sophie	Rosset Sophie	Industriel	17 250	CIFRE
01/09/12	30/08/14		Collaboration de recherche	A2IA	Ney Hermann	Yvon François	Industriel	8 040	
16/09/02	16/09/16		Contrat de prestations de service	Vecsys Research/ Vocapia Research	Gauvain Jean-Luc	Gauvain Jean-Luc	Industriel	166 000	Autre
20/02/14	19/02/17		Collaboration de recherche	ARDM	Yvon François	Yvon François	Associatif	-	CIFRE
02/02/12	31/12/99		Mise à disposition	ELDA	Lamel Lori	Lamel Lori	Associatif	-	
06/12/11	31/12/99	Corpus CHIL	Mise à disposition	ELDA	Rosset Sophie	Lamel Lori	Associatif	-	
04/11/11	31/12/99	Corpus émissions TV et radio	Mise à disposition	ELDA	Barras Claude	Barras Claude	Associatif	-	
28/12/11	31/12/99	Corpus QUAERO	Mise à disposition	ELDA	Rosset Sophie	Rosset Sophie	Associatif	-	
27/05/09	27/05/20	SDC	Mise à disposition	NTU-INL	Lamel Lori	Lamel Lori	Européen	-	

Starting date	Ending date	Acronym	Category	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
28/02/02	27/02/20		Mise à disposition	INA	Gauvain Jean-Luc	Gauvain Jean-Luc	Industriel	-	
29/01/13	28/01/23	Prêt du Corpus U-STAR	Mise à disposition	Harbin Institute of Technology	Yvon François	Yvon François	International	-	
29/03/13	31/03/16	U-STAR Technology license agreement	Mise à disposition	NICT	Gauvain Jean-Luc	Gauvain Jean-Luc	International	-	
27/11/13	31/12/19	Corpus INA - Matrice	Mise à disposition	INA	Peschanski Denis	Gauvain Jean-Luc	National	-	
15/02/12	31/12/99	MOBIO Corpus	Mise à disposition	IDIAP	Barras Claude	Barras Claude	National	-	
08/06/12	07/07/15		Accord de secret	Reverso-Softissimo	Yvon François	Yvon François	Industriel	-	

Valorization

Patents, software, licence agreements…			
Software registration (APP)	**LIMSI Author**	**Co-authors**	**Date**
IDIAL : distributed architecture and integration platform fot information and interaction processing	Rosset Sophie	Galibert Olivier	01/06/2013

Scientific publications

Doctoral theses and HdR

1. Allauzen, A., *Modèles statistiques pour la traduction automatique*, 2014, HdR Université Paris-Sud, soutenue à Orsay, France, le 30/01/14. 84 p.
2. Delaborde, A., *Modélisation du profil émotionnel de l'utilisateur dans les interactions parlées Humain-Machine* 2013, thèse de LIMSI-CNRS. Soutenue à Orsay, France, le 19 décembre 2013, 201p p.
3. Dutrey, C., *Analyse et détection automatique de disfluences dans la parole spontanée conversationnelle* 2014, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 16/2/2014, 130 p.
4. Foucault, N., *Questions-Réponses en domaine ouvert : sélection pertinente de documents en fonction du contexte de la questions* 2013, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 16/12/2013, 143 p.
5. Fraga Da Silva, T.H., *Reducing development costs of large vocabulary speech recognition systems* 2014, thèse de l'LIMSI. Soutenue à Orsay, France, le 29/09/2014, 169 p.
6. Gahbiche-Braham, S., *Amélioration des systèmes de traduction par analyse linguistique et thématique : application à la traduction depuis l'arabe* 2013, thèse de l'LIMSI-CNRS. Soutenue à Orsay, France, le 30 septembre 2013, 154p p.
7. Gong, L., *On-demand Development of Statistical Machine Translation Systems* 2014, thèse de l'LIMSI-CNRS. Soutenue à Orsay, France, le 2014-11-25, 136 p.
8. Karanasou, P., *Phonemic variability and confusability in pronunciation modeling for automatic speech recognition* 2013, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 11 juin 2013, 128p p.
9. Soury, M., *Détection multimodale du stress pour la conception de logiciels de remédiation Date de soutenance : 28/10/2014 Composition du* 2014, thèse soutenue à Orsay, France, le 28/10/2014, 221 p.

Articles in peer reviewed scientific journals

1. Ananiadou, S., N. Friburger, and S. Rosset, *Entités Nommées, Traitement Automatique des langues.* TAL (Traitement Automatique des Langues), 2014. **54** (2): pp.7-11.
2. Apidianaki, M., N. Ljubešic, and D. Fišer, *Vector disambiguation for translation extraction from comparable corpora.* Informatica, 2013. **37** (2): pp.193-201.
3. Apidianaki, M. and B. Sagot, *Data-driven Synset Induction and Disambiguation for Wordnet Development.* Language Resources and Evaluation, 2014. **48** (4): pp.655-677.
4. Barras, C., A.K. Sarkar, C.-T. Do, and V.B. Le, *Combination of Cepstral and Phonetically Discriminative Features for Speaker Verification.* IEEE Signal Processing Letters, 2014. **21** (9): pp.5.
5. Boula De Mareüil, P., *Qu'est-ce qu'un (phono)style ?* Nouveaux cahiers de linguistique française, 2014. 31: pp.9-19.
6. Boula De Mareüil, P., G. Adda, M. Adda-Decker, C. Barras, B. Habert, and P. Paroubek, *Une étude quantitative des marqueurs discursifs, disfluences et chevauchements de parole dans des interviews politiques.* TIPA. Travaux interdisciplinaires sur la parole et le langage, 2013. **29**: pp.18.
7. Boula De Mareüil, P., C. Woehrling, and M. Adda-Decker, *Contribution of automatic speech processing to the study of Northern/Southern French.* Language Sciences, 2013. **39**: pp.75-82.
8. Bredin, H., A. Roy, V.-B. Le, and C. Barras, *Person instance graphs for mono-, cross- and multi-modal person recognition in multimedia data. Application to speaker identification in TV broadcast.* International Journal of Multimedia Information Retrieval, 2014. pp.16.
9. Clavel, C., G. Adda, F. Cailliau, M. Garnier-Rizet, A. Cavet, G. Chapuis, S. Courcinous, C. Danesi, A. Daquo, M. Deldossi, S. Guillemin-Lanne, M. Seizou, and P. Suignard, *Spontaneous speech and opinion detection: mining call-centre transcripts.* Language Resources and Evaluation, 2013. **48** (1): pp.1-37.
10. Devillers, L., *Les dimensions affectives et sociales dans les interactions humain-robot.* Interfaces numériques, 2013. **2** (1): pp.105-117.
11. Gahbiche-Braham, S., H. Maynard, and F. Yvon, *Traitement automatique des entités nommées en arabe : détection et traduction.* TAL (Traitement Automatique des Langues), 2014. **54** (2): pp.101-132.
12. Hua, J., C. Le Scanff, J. Larue, F. José, J.-C. Martin, L. Devillers, and E. Filaire, *Global stress response during a social stress test: Impact of alexithymia and its subfactors.* Psychoneuroendocrinology, 2014. (50): pp.53-61.
13. Lardilleux, A., F. Yvon, and Y. Lepage, *Generalizing sampling-based multilingual alignment.* Machine Translation, 2013. **27** (1): pp.1-23.
14. Le, H.S., I. Oparin, A. Allauzen, J.-L. Gauvain, and F. Yvon, *Structured output layer neural network language models for speech recognition.* IEEE Transactions on Audio, Speech and Language Processing, 2013. 21 (1): pp.197-206.
15. Leroux, C., O. Lebec, M.W. Ben Ghezala, Y. Mezouar, L. Devillers, C. Chastagnol, J.-C. Martin, V. Leynart, and C. Fattal, *ARMEN: Assistive robotics to maintain elderly people in natural environment.* IRBM, 2013. 34 (2): pp.101-107.
16. Luzzati, D., M. Adda-Decker, and S. Rosset, *Traitements automatiques de l'oral et de l'écrit.* L'information grammaticale, 2014. **141** (mars 2014): pp.4-8.
17. Rosset, S. and D. Luzzati, *le dialogue humain-machine ou la confrontation au sens.* L'information grammaticale, 2014. **141** (mars 2014): pp.47-53.
18. Roy, A., H. Bredin, W. Hartmann, V.B. Le, C. Barras, and J.-L. Gauvain, *Lexical speaker identification in TV shows.* Multimedia Tools and Applications, 2014. pp.20.
19. Schuller, B., S. Steidl, A. Batliner, F. Burkhardt, L. Devillers, C. Müller, and S. Narayanan, *Paralinguistics in speech and language—State-of-the-art and the challenge.* Computer Speech and Language, 2013. 27 (1): pp.4-39.
20. Sokolov, A., G. Wisniewski, and F. Yvon, *Lattice BLEU oracles in machine translation.* ACM Transactions on Speech and Language Processing, 2013. **10** (4): pp.18_1-18_29.
21. Wisniewski, G., A.K. Singh, and F. Yvon, *Quality estimation for machine translation: some lessons learned.* Machine Translation, 2013. pp.1-26.
22. Wisniewski, G. and F. Yvon, *Oracle decoding as a new way to analyze phrase-based machine translation.* Machine Translation, 2013. **27** (2): pp.115-138.
23. Zweigenbaum, P., T. Lavergne, N. Grabar, T. Hamon, S. Rosset, and C. Grouin, *Combining an expert-based medical entity recognizer to a machine-learning system: methods and a case-study.* Biomedical Informatics Insights, 2013. pp.13p.

Books & chapters in books

1. Adda, G., K. Fort, B. Sagot, J.-J. Mariani, and A. Couillault, *Crowdsourcing for language resource development: criticisms about Amazon Mechanical Turk overpowering use*, in *Human Language Technology Challenges for Computer Science and Linguistics - 5th Language and Technology Conference, LTC 2011, Poznan, Poland, November 25-27, 2011, Revised Selected Papers*, Vetulani Zygmunt and Mariani Joseph, Eds. 2014, Springer International Publishing. pp. 303-314.
2. Adda, G., J.-J. Mariani, L. Besacier, and H. Gelas, *Economic and ethical background of crowdsourcing for speech*, in *Crowdsourcing for Speech Processing: Applications to Data Collection, Transcription and Assessment*, G. A. Levow H. Meng G. Parent D. Suendermann M. Eskenazi, Editor. 2013, Wiley. pp. 303-334.
3. Adda-Decker, M., G. Adda, and L. Lamel, *Systèmes de transcription comme instruments*, in *Méthodes et outils pour l'analyse phonétique des grands corpus oraux*, Adda-Decker Martine Nguyen Noël, Editor. 2013, Hermès science. pp. 159-202.
4. Adda-Decker, M., C. Gendrot, N. Snoeren, and N. Nguyen, *Apport du traitement automatique à l'étude des voyelles*, in *Méthodes et outils pour l'analyse phonétique des grands corpus oraux*, Adda-Decker Martine Nguyen Noël, Editor. 2013, Hermès science. pp. 187-214.
5. Adda-Decker, M., L. Lamel, G. Adda, and T. Lavergne, *A first LVCSR system for Luxembourgish*, in *Human Language Technology Challenges for Computer Science and Linguistics - 5th Language and Technology Conference, LTC 2011, Poznan, Poland, November 25-27, 2011, Revised Selected Papers*, Vetulani Zygmunt and Mariani Joseph, Eds. 2014, Springer International Publishing. pp. 479-490.
6. Bardiaux, A. and P. Boula De Mareüil, *Allongements vocaliques en français de Belgique : une approche perceptive*, in *La perception des accents du français hors de France*, A. Falkert, Editor. 2013, Éditions CIPA. pp. 21-40.
7. Boula De Mareüil, P. and B.A. Boutin, *Perception et caractérisation d'accents ouest-africains en français*, in *La perception des accents du français hors de France*, A. Falkert, Editor. 2013, Éditions CIPA. pp. 61-80.
8. Boula De Mareüil, P., C. Woehrling, and M. Adda-Decker, *Apports du traitement automatique à une approche linguistique de la variation régionale dans la parole*, in *Méthodes et outils pour l'analyse phonétique des grands corpus oraux*, Adda-Decker Martine Nguyen Noël, Editor. 2013, Hermès science. pp. 145-165.
9. Boula De Mareüil, P., C. Woehrling, and M. Adda-Decker, *Traitement de la variation régionale*, in *Méthodes et outils pour l'analyse phonétique des grands corpus oraux*, Noël Adda-Decker Martine Nguyen, Editor. 2013, Hermès Science. pp. 203-230.
10. Buendia, A. and L. Devillers, *From informative cooperative dialogues to long-term social relation with a robot*, in *Towards a Natural Interaction with Robots, Knowbots and Smartphones, Putting Spoken Dialog Systems into Practice*, J. Mariani, et al., Eds. 2013, Springer.
11. Chastagnol, C., C. Clavel, M. Courgeon, and L. Devillers, *Designing an emotion detection system for a socially-intelligent human-robot interaction*, in *Towards a Natural Interaction with Robots, Knowbots and Smartphones, Putting Spoken Dialog Systems into Practice*, J. Mariani, et al., Eds. 2013, Springer.
12. Despres, J., L. Lamel, J.-L. Gauvain, B. Dimulescu-Vieru, C. Woehrling, V.B. Le, and I. Oparin, *The Vocapia research ASR systems for Evalita 2011*, in *Evaluation of Natural Language and Speech Tool for Italian (Proceedings of EVALITA 2011, Rome, Italy, ISSN 2240-5186) Lecture Notes in Computer Science, Vol. 7689*, B. Magnini, et al., Eds. 2013, Springer. pp. 286-294.
13. Devillers, L., *Automatic detection of emotion from real-life data*, in *Prosody and Iconicity*, Hancil Sylvie and Hirst Daniel, Eds. 2013, John Benjamins Publishing Company. pp. 219-231.
14. Langlais, P. and F. Yvon, *Issues in analogical inference over sequences of symbols: a case study on proper name transliteration*, in *Computational approaches to analogical reasoning: current trends*, H. Prade and G. Richard, Eds. 2014, Springer-Verlag Berlin Heidelberg. pp. 59-82.
15. Mariani, J.-J., *How Language Technologies support Multilingualism*, in *NET.LANG : Towards the Multilingual Cyberspace, Russian Edition*, Maaya Network, Editor. 2014, C&F. pp. 148-168.
16. Mariani, J.-J. and G. Francopoulo, *Language Matrices & the Language Resource Impact Factor*, in *Language Production, Cognition, and the Lexicon, Festschrift in honour of Michael Zock*, R. Rapp G. Bel N. Gala, Editor. 2014, Springer. pp. 20.
17. Mariani, J.-J., S. Rosset, M. Garnier-Rizet, and L. Devillers, *Natural Interaction with robots, knowbots and smartphones - Putting Spoken dialog systems into practice* 2013: Springer. 397p.

18. Mariani, J.-J. and Z. Vetulani, *Human Language Technology Challenges for Computer Science and Linguistics* 2014: Springer. 550p.
19. Vetulani, Z. and J.-J. Mariani, *Preface*, in *Human Language Technology Challenges for Computer Science and Linguistics*, J. Mariani Z. Vetulani, Editor. 2014, Springer. pp. IV-X.
20. Yvon, F., *Machine Translation*, in *Oxford Bibliographies in Linguistics*, Aronoff Mark, Editor. 2014, New York: Oxford University Press. pp. 28p.

Conferences with proceedings and review committee

1. Adda, G., M. Adda-Decker, and L. Lamel. *Speech alignment and recognition experiments for luxembourgish*. in *International Workshop on Spoken Languages Technologies for Under-resourced languages*. 2014. St Petersburg, Russia. 53-60.
2. Adda, G., L. Besacier, A. Couillault, K. Fort, J.-J. Mariani, and H. de Mazancourt. *Where the data are coming from? Ethics, crowdsourcing and traceability for Big Data in Human Language Technology*. in *Crowdsourcing and human computation multidisciplinary workshop*. 2014. Paris, France: CNRS. 2.
3. Adda, G., O. Galibert, J. Leixa, K. Choukri, and G. Gravier. *The ETAPE speech processing evaluation*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 5.
4. Adda-Decker, M., L. Lamel, and G. Adda. *Modélisation acoustico-phonétique de langues peu dotées : Études phonétiques et travaux de reconnaissance automatique en luxembourgois*. in *Journées d'Etude sur la Parole*. 2014. Le Mans (France). 9.
5. Allauzen, A., Q.K. Do, and F. Yvon. *Modèles de langue neuronaux: une comparaison de plusieurs stratégies d'apprentissage*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2014. Marseille. 12.
6. Allauzen, A., N. Pécheux, Q.K. Do, M. Dinarelli, T. Lavergne, A. Max, H.S. Le, and F. Yvon. *LIMSI @ WMT13*. in *8th Workshop on Statistical Machine Translation (WMT 2013)*. 2013: ACL. 62-69.
7. Apidianaki, M. *Cross-lingual word sense disambiguation using translation sense clustering*. in *7th International Workshop on Semantic Evaluation (SemEval 2013)*. 2013: ACL. 5p.
8. Apidianaki, M., N. Ljubešic, and D. Fišer. *Cross-lingual WSD for translation extraction from comparable corpora*. in *6th Workshop on Building and Using Comparable Corpora (BUCC 2013)*. 2013: ACL. 1-10.
9. Apidianaki, M. and L. van der Plas. *Cross-lingual Word Sense Disambiguation for Predicate Labelling of French*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2014. Marseille, France. 46-55.
10. Apidianaki, M., E. Verzeni, and D. McCarthy. *Semantic clustering of pivot paraphrases*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 4270-4275.
11. Ben Jannet, M., M. Adda-Decker, O. Galibert, J. Kahn, and S. Rosset. *ETER: a new metric for the evaluation of hierarchical named entity recognition*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 1-8.
12. Ben Jannet, M.A., M. Adda-Decker, O. Galibert, J. Kahn, and S. Rosset. *Comment évaluer la qualité des transcriptions automatiques pour la détection d'entités nommées ?* in *Journées d'Etude sur la Parole*. 2014. Le Mans, France. 9.
13. Bluche, T., J. Louradour, M. Knibbe, B. Moysset, F. Benzeghiba, and C. Kermorvant. *The A2iA Arabic Handwritten text recognition system at the OpenHaRT2013 Evaluation*. in *International Workshop on Document Analysis Systems*. 2014. Tours, France. 161-165.
14. Bluche, T., B. Moysset, and C. Kermorvant. *Automatic Line Segmentation and Ground-Truth Alignment of Handwritten Documents*. in *International Conference on Frontiers in Handwriting Recognition*. 2014. Crete Island, Greece. 6.
15. Bluche, T., H. Ney, and C. Kermorvant. *Tandem HMM with convolutional neural network for handwritten word recognition*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2013. Vancouver, Canada. 5p.
16. Bluche, T., H. Ney, and C. Kermorvant. *Feature extraction with convolutional neural networks for handwritten word recognition*. in *International Conference on Document Analysis and Recognition*. 2013. Washington DC, USA. 5p.
17. Bluche, T., H. Ney, and C. Kermorvant. *A comparison of sequence-trained deep neural networks and recurrent neural networks optical modeling for handwriting recognition*. in *International Conference on Statistical Language and Speech Processing*. 2014. Grenoble, France: Laurent Besacier, Adrian-Horia Dediu, and Carlos Martín-Vide. 199-210.

18. Bluche, T., V. Pham, C. Kermorvant, and J. Louradour. *Dropout improves recurrent neural networks for handwriting recognition*. in *International Conference on Frontiers in Handwriting Recognition*. 2014. Crete Island, Greece. 6.
19. Boula De Mareüil, P., A. Rilliard, and F. Ivent. *Une étude prosodique comparative des questions en français en contact avec l'occitan*. in *Journées d'Etude sur la Parole*. 2014. Le Mans. 10.
20. Boula De Mareüil, P., A. Rilliard, I. Lehka-Lemarchand, and F. Ivent. *Regional accents and languages in France: a contrastive prosodic analysis of Romance varieties*. in *Workshop on Phonetics, Phonology and Languages in Contact (PPLC 2013)*. 2013: ISCA. 72-75.
21. Boula De Mareüil, P., M. Vitale, and A. De Meo. *An acoustic-perceptual approach to the prosody of Chinese and native speakers of Italian based on yes/no questions*. in *International Conference on Speech Prosody*. 2014. Dublin, Ireland. 648-652.
22. Bredin, H., A. Laurent, A.K. Sarkar, V.-B. Le, S. Rosset, and C. Barras. *Person instance graphs for named speaker identification in TV broadcast*. in *The Speaker and Language Recognition Workshop*. 2014. Joensuu, Finlande. 8.
23. Bredin, H. and J. Poignant. *Integer linear programming for speaker diarization and cross-modal identification in TV broadcast*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 5p.
24. Bredin, H., J. Poignant, G. Fortier, M. Tapaswi, V.B. Le, A. Roy, C. Barras, S. Rosset, A.K. Sarkar, Q. Yang, H. Gao, A. Mignon, J. Verbeek, L. Besacier, G. Quénor, H.K. Ekenel, and R. Stiefelhagen. *QCompere @ REPERE 2013*. in *First Workshop on Speech, Language and Audio in Multimedia (SLAM 2013)*. 2013: ISCA / IEEE. 49-54.
25. Bruneau, P., M. Stefas, H. Bredin, A.-P. Ta, T. Tamisier, and C. Barras. *A Web-based Tool for the Visual Analysis of Media Annotations*. in *International Conference Information Visualisation*. 2014. Paris, France. 6.
26. Candea, M., M. Adda-Decker, and L. Lamel. *Recent Evolution of Non Standard Consonantal Variants in French Broadcast News*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France: International Speech Communication Association, F. Bimbot, C. Cerisara, C. Fougeron, G. Gravier, L. Lamel, F. Pellegrino, P. Perrier. 412-416.
27. Charlet, D., C. Barras, and J.-S. Liénard. *Impact of overlapping speech detection on speaker diarization for broadcast news and debates*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2013. Vancouver, Canada. 5p.
28. Couillault, A., K. Fort, G. Adda, and H. de Mazancourt. *Evaluating corpora documentation with regards to the Ethics and Big Data Charter*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 5.
29. Del Gratta, R., F. Frontini, K. Fahad, J.-J. Mariani, and C. Soria. *The LREMap for under-resourced languages*. in *Workshop CCURL 2014 : Collaboration and Computing for Under-Resourced Languages in the Linked Open Data Era*. 2014. Reykjavik, Islande. 6.
30. Devillers, L. and M. Soury. *A social interaction system for studying humor with the robot NAO*. in *International Conference on Multimodal Interaction*. 2013. Sydney, Australia: ACM. 313-314.
31. Do, C.-T., C. Barras, V.-B. Le, and A.K. Sarkar. *Augmenting short-term cepstral features with long-term discriminative features for speaker verification of telephone data*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 2484-2488.
32. Do, C.-T., L. Lamel, and J.-L. Gauvain. *Speech-to-Text Development for Slovak, a Low-Resourced Language*. in *International Workshop on Spoken Languages Technologies for Under-resourced languages*. 2014. St. Petersburg. 7.
33. Do, Q.-K., A. Allauzen, and F. Yvon. *Discriminative Adaptation of Continuous Space Translation Models*. in *International Workshop on Spoken Language Translation*. 2014. South Lake Tahoe, California, États-Unis. 192-199.
34. Dutrey, C., S. Rosset, M. Adda-Decker, C. Clavel, and I. Vasilescu. *Disfluences dans la parole spontanée conversationnelle : détection automatique utilisant des indices lexicaux et acoustiques*. in *Journées d'Etude sur la Parole*. 2014. Le Mans, France. 9.
35. Fillon, T., J. Simonnot, M.-F. Mifune, S. Khoury, G. Pellerin, M. Le Coz, E. Amy de la Bretèque, D. Doukhan, D. Fourer, J.-L. Rouas, J. Pinquier, J. Mauclair, and C. Barras. *Telemeta: An open-source web framework for ethnomusicological audio archives management and automatic analysis*. in *International Digital Libraries for Musicology*. 2014. London, UK. 8.
36. Foucault, N., S. Rosset, and G. Adda. *Pré-segmentation de pages web et sélection de documents pertinents en Questions-Réponses*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Sables d'Olonne, France. 14p.

37. Fraga Da Silva, T., J.-L. Gauvain, and L. Lamel. *Interpolation of acoustic models for speech recognition*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 3347-3351.
38. Fraga Da Silva, T., J.-L. Gauvain, and L. Lamel. *Speech recognition of multiple accented English data using acoustic model interpolation*. in *European Signal Processing Conference*. 2014. Lisboa, Portugal. 5.
39. Gahbiche-Braham, S., H. Maynard, and F. Yvon. *Adaptation thématique pour la traduction automatique de dépêches de presse*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2014. Marseille, France. 280-291.
40. Gauvain, J.-L., I. Vasilescu, B. Vieru, and L. Lamel. *Analyzing linguistic variation in a Romanian speech corpus through ASR errors*. in *Laboratory Approaches to Romance Phonology*. 2014. Aix-en-Provence, France. 2.
41. Giraud, T., M. Soury, J. Hua, A. Delaborde, M. Tahon, D.A. Gomez Jauregui, M.V. Eyharabide, E. Filaire, C. Le Scanff, L. Devillers, B. Isableu, and J.-C. Martin. *Multimodal expressions of stress during a public speaking task*. in *International Conference on Affective Computing and Intelligent Interaction*. 2013. Genève, Suisse. 417-422.
42. Gong, L., A. Max, and F. Yvon. *Improving bilingual sub-sentential alignment by sampling-based transpotting*. in *International Workshop on Spoken Language Translation*. 2013. Heidelberg, Germany: Joy Zhang. 8p.
43. Gong, L., A. Max, and F. Yvon. *Vers un développement plus efficace des systèmes de traduction statistique : un peu de vert dans un monde de BLEU*. in *Traitement Automatique du Langage Naturel*. 2014. Marseilles, France. 395-400.
44. Gong, L., A. Max, and F. Yvon. *Incremental Development of Statistical Machine Translation Systems*. in *International Workshop on Spoken Language Translation*. 2014. South Lake Tahoe, CA. 214--222.
45. Goryainova, M., C. Grouin, S. Rosset, and I. Vasilescu. *Morpho-Syntactic Study of Errors from Speech Recognition System*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 5p.
46. Grouin, C., V. Moriceau, S. Rosset, and P. Zweigenbaum. *Risk factor identification from clinical records for diabetic patients*. in *i2b2/UTHealth NLP Workshop*. 2014: LIMSI. 5.
47. Hartmann, W., L. Lamel, and J.-L. Gauvain. *Efficient Rule Scoring for Improved Grapheme-Based Lexicons*. in *European Signal Processing Conference*. 2014. Lisbon. 5.
48. Hartmann, W., L. Lamel, and J.-L. Gauvain. *Cross-Word Sub-Word Units for Low-Resource Keyword Spotting*. in *International Workshop on Spoken Languages Technologies for Under-resourced languages*. 2014. St. Petersburg. 6.
49. Hartmann, W., V.B. Le, A. Messaoudi, L. Lamel, and J.-L. Gauvain. *Comparing decoding strategies for subword-based keyword spotting in low-resourced languages*. in *Annual Conference of the International Speech Communication Association*. 2014. Singapore: ISCA. 2764-2768.
50. Karakos, Schwartz, Tsakalidis, l. zhang, s. ranjan, t. ng, R. Hsiao, G. saikumar, I. Bulyko, L. Nguyen, L. Lamel, and V.B. Le. *Score Normalization and System Combination for Improved Keyword Spotting*. in *IEEE Automatic Speech Recognition and Understanding Workshop*. 2013. Olomouc, Czech Republic. 6.
51. Karanasou, P., F. Yvon, T. Lavergne, and L. Lamel. *Discriminative training of a phoneme confusion model for a dynamic lexicon in ASR*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 5p.
52. Laurent, A., C. Guinaudeau, and A. Roy. *Analyse du corpus MATRICE-INA : exploration et classification automatique d'archives audiovisuelles de 1930 a` 2012*. in *Journées d'Etude sur la Parole*. 2014. Le Mans, France. 8.
53. Laurent, A., W. Hartmann, and L. Lamel. *Unsupervised Acoustic Model Training for the Korean Languag*. in *International Symposium on Chinese Spoken Language Processing*. 2014. Singapore. 5.
54. Laurent, A. and L. Lamel. *Développement d'un système de reconnaissance automatique de la parole en coréen avec peu de ressources annotées*. in *Journées d'Etude sur la Parole*. 2014. Le Mans, France. 9.
55. Laurent, A. and L. Lamel. *Development of a Korean speech recognition system with little annontated data*. in *International Workshop on Spoken Languages Technologies for Under-resourced languages*. 2014. St Petersburg, Russia. 146-152.
56. Lavergne, T., G. Adda, M. Adda-Decker, and L. Lamel. *Automatic language identity tagging on word and sentence-level in multilingual text sources: a case-study on Luxembourgish*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 5.
57. Lavergne, T., A. Allauzen, and F. Yvon. *un cadre d'apprentissage intégralement discriminant pour la traduction statistique*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Les Sables d'Olonne. 14p.

58. Lehnen, P., A. Allauzen, T. Lavergne, F. Yvon, S. Hahn, and H. Ney. *Structure learning in hidden conditional random fields for grapheme-to-phoneme conversion*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 5p.
59. Letard, V. *Interaction homme-machine en domaine large à l'aide du langage naturel : une amorce par mise en correspondance*. in *Rencontres des Etudiants Chercheurs en Informatique pour le Traitement Automatique des Langues*. 2014. Marseille, France. 81-91.
60. Letard, V., S. Rosset, and G. Illouz. *A mapping-based approach for general formal human computer interaction using natural language*. in *Annual Meeting of the Association for Computational Linguistics*. 2014. Baltimore, Maryland, USA. 34-40.
61. Liénard, J.-S. and C. Barras. *Fine-grain voice strength estimation from vowel spectral cues*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 128-132.
62. Liénard, J.-S. and C. Barras. *Étude des voyelles et de la force de voix par analyse discriminante*. in *Journées d'Etude sur la Parole*. 2014. Le Mans, France. 9.
63. Lonneke van der, P., M. Apidianaki, and C. Chen. *Global methods for cross-lingual semantic role and predicate labelling*. in *25th International Conference on Computational Linguistics*. 2014. Dublin, Ireland. 1279–1290.
64. Luzzati, D., C. Grouin, I. Vasilescu, M. Adda-Decker, E. Bilinski, N. Camelin, J. Kahn, C. Lailler, L. Lamel, and S. Rosset. *Human annotation of ASR error regions: Is "gravity" a sharable concept for human annotators?* in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 7p.
65. Mariani, J.-J. *Language Technologies in Support to Multilingualism*. in *Linguistic and Cultural Diversity in Cyberspace*. 2014. Yakutsk, Russian Federation. 9.
66. Mariani, J.-J., G. Adda, and L. Besacier. *Analyse économique, juridique et éthique du crowdsourcing pour le TAL*. in *Ethique et Traitement Automatique des Langues*. 2014: ATALA. 3.
67. Mariani, J.-J., C. Cieri, G. Francopoulo, P. Paroubek, and M. Delaborde. *Facing the identification problem in language-related scientific data analysis*. in *Language Resources and Evaluation 2014*. 2014. Reykjavik, Islande. 7.
68. Mariani, J.-J., P. Paroubek, G. Francopoulo, and M. Delaborde. *Rediscovering 25 years of discoveries in spoken language processing: a preliminary analysis of the ISCA archive*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 33p.
69. Max, A., L. Gong, and F. Yvon. *Construction (très) rapide de tables de traduction à partir de grands bi-textes*. in *Traitement Automatique du Langage Naturel*. 2014. Marseille, France. 26-27.
70. Maynard, H., N. Segal, E. Bilinski, J.-L. Gauvain, L. Gong, L. Lamel, A. Laurent, F. Yvon, J. Despres, y. josse, and V.B. Le. *Traduction de la parole dans le projet RAPMAT*. in *Journées d'Études sur la Parole*. 2014. Le Mans. 9.
71. Mbengue, C., D.A. Gomez Jauregui, and J.-C. Martin. *CONTACT: A Multimodal Corpus for Studying Expressive Styles and Informing the Design of Individualized Virtual Narrators*. in *6th Workshop on Intelligent Narrative Technologies*. 2013. Boston, USA. 86-88.
72. Moysset, B., T. Bluche, M. Knibbe, M.F. Benzeghiba, R. Messina, J. Louradour, and C. Kermorvant. *The A2iA Multi-lingual Text Recognition System at the second Maurdor Evaluation*. in *International Conference on Frontiers in Handwriting Recognition*. 2014. Crete Island, Greece. 6.
73. Névéol, A., C. Grouin, J. Leixa, S. Rosset, and P. Zweigenbaum. *The Quaero french medical corpus: a ressource for medical entity recognition and normalization*. in *Bio text-mining workshop*. 2014. Reykjavik, Iceland. 7p.
74. Névéol, A., A. Max, Y. Ivanishcheva, P. Ravaud, P. Zweigenbaum, and F. Yvon. *Statistical machine translation of systematic reviews into French*. in *Workshop on Optimizing understanding in multilingual hospital encounters*. 2013: Université Paris 13. 4p.
75. Niehues, J., A. Allauzen, F. Yvon, and A. Waibel. *Combining techniques from different NN-based language models for machine translation*. in *Conference of the Association for Machine Translation in the Americas*. 2014. Vancouver, BC Canada: Yaser Al-Onaizan and Michel Simard. 222-233.
76. Pécheux, N., A. Allauzen, and F. Yvon. *Rule-based reordering spaces in statistical machine translation*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 7p.
77. Pécheux, N., L. Gong, Q.K. Do, B. Marie, Y. Ivanishcheva, A. Allauzen, T. Lavergne, J. Niehues, A. Max, and F. Yvon. *LIMSI @ WMT'14 Medical Translation Task*. in *9th Workshop on Statistical Machine Translation (WMT 2014)*. 2014: ACL. 8.
78. Pellegrini, T., A. Hämäläinen, P. Boula De Mareüil, M. Tjalve, I. Trancoso, S. Candeias, M. Sales Dias, and D. Braga. *A corpus-based study of elderly and young speakers of European Portuguese: acoustic correlates*

and their impact on speech recognition performance. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 852-856.
79. Poignant, J., L. Besacier, V.B. Le, S. Rosset, and G. Quénot. *Unsupervised naming of speakers in broadcast TV: using written names, pronounced names or both?* in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 1-4.
80. Poignant, J., H. Bredin, L. Besacier, G. Quénot, and C. Barras. *Towards a better integration of written names for unsupervised speakers identification in videos*. in *First Workshop on Speech, Language and Audio in Multimedia (SLAM 2013)*. 2013: ISCA / IEEE. 84-89.
81. Rosset, S., C. Dutrey, C. Clavel, I. Vasilescu, and M. Adda-Decker. *A CRF-based approach to automatic disfluency detection in a french call-centre corpus*. in *Annual Conference of the International Speech Communication Association*. 2014. Singapore. 5.
82. Rosset, S., C. Grouin, T. Lavergne, M. Ben Jannet, J. Leixa, O. Galibert, and P. Zweigenbaum. *Automatic named entity pre-annotation for out-of-domain human annotation*. in *Linguistic Annotation Workshop*. 2013. Sofia, Bulgaria: ACL. 10p.
83. Roy, A., C. Guinaudeau, H. Bredin, and C. Barras. *TVD: a reproducible and multiply aligned TV series dataset*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 418-425.
84. Roy, A., L. Lamel, T. Fraga Da Silva, J.-L. Gauvain, and I. Oparin. *Some issues affecting the transcription of hungarian broadcast audio*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 3102-3106.
85. Sarkar, A.K. and C. Barras. *Anchor and UBM-based multi-class MLLR M-Vector system for speaker verification*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 2450-2454.
86. Sarkar, A.K. and C. Barras. *Multi-class UBM-Based MLLR m-Vector system for speaker verification*. in *European Signal Processing Conference*. 2013. Marrakech, Morocco. 6p.
87. Sarkar, A.K., C. Barras, and V.B. Le. *Lattice MLLR based m-vector system for speaker verification*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2013. Vancouver, Canada. 5p.
88. Schmiedeke, S., P. Xu, I. Ferrané, M. Eskevich, C. Kofler, M.A. Larson, Y. Estève, L. Lamel, G.J.F. Jones, and T. Sikora. *Blip10000: A social video dataset containing SPUG content for tagging and retrieval*. in *Multimedia Systems Conference*. 2013. Oslo, Norway. 6p.
89. Segal, N., H. Maynard, Q.K. Do, A. Allauzen, J.-L. Gauvain, L. Lamel, and F. Yvon. *LIMSI English-French Speech Translation System*. in *International Workshop on Spoken Language Translation (IWSLT)*. 2014. 106-112.
90. Singh, A.K., G. Wisniewski, and F. Yvon. *LIMSI submission for the WMT 13 quality estimation task: an experiment with n-gram posteriors*. in *8th Workshop on Statistical Machine Translation (WMT 2013)*. 2013: ACL. 398-404.
91. Soria, C. and J.-J. Mariani. *Searching LTs for minority languages*. in *Traitement Automatique des Langues Régionales de France et d'Europe (TALaRE 2013)*. 2013: ATALA. 13p.
92. Soria, C., J.-J. Mariani, and C. Zoli. *Dwarfs sitting on the giants' shoulders - how LTs for regional and minority languages can benefit from piggybacking major languages*. in *Conference of the Foundation for Endangered Languages*. 2013. Ottawa, Canada. 1.
93. Soury, M. and L. Devillers. *Stress detection from audio on multiple window analysis size in a public speaking task*. in *International Conference on Affective Computing and Intelligent Interaction*. 2013. Geneva, Switzerland: IEEE Computer Society. 529-533.
94. Soury, M. and L. Devillers. *Nao makes me laugh: the impact of humor in human- robot interactions*. in *Towards social humanoid robots: what makes interaction human-like?* 2013: IROS2013.
95. Soury, M. and L. Devillers. *Smile and Laughter in Human-Machine Interaction: a study of engagement*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 3633-3637.
96. Vasilescu, I., B. Vieru, and L. Lamel. *Exploring Pronunciation Variants for Romanian Speech-to-Text Transcription*. in *International Workshop on Spoken Languages Technologies for Under-resourced languages*. 2014. St. Petersburg. 8.
97. Viet-Bac, L., L. Lamel, A. Messaoudi, W. Hartmann, J.-L. Gauvain, C. Woehrling, and J. Despres. *Developing stt and kws systems using limited language resources*. in *Interspeech*. 2014. Singapore: ISCA. 2484-2488.
98. Wisniewski, G. *On the predictability of human assessment: when matrix completion meets NLP evaluation*. in *Annual Meeting of the Association for Computational Linguistics*. 2013. Sofia, Bulgaria: Association for Computational Linguistics. 137-142.

99. Wisniewski, G., N. Kübler, and F. Yvon. *A Corpus of Machine Translation Errors Extracted from Translation Students Exercises*. in *International Conference on Language Resources and Evaluation*. 2014. Reykjavik, Iceland. 4p.
100. Wisniewski, G., N. Pécheux, A. Allauzen, and F. Yvon. *LIMSI Submission for WMT'14 QE Task*. in *Workshop on Machine Translation*. 2014. Baltimore, USA. 7.
101. Wisniewski, G., N. Pécheux, S. Gahbiche-Braham, and F. Yvon. *Cross-Lingual Part-of-Speech Tagging through Ambiguous Learning*. in *Conference on Empirical Methods in Natural Language Processing*. 2014. Doha, Qatar. 7.
102. Wisniewski, G., N. Pécheux, E. Knyazeva, A. Allauzen, and F. Yvon. *Apprentissage partiellement supervisé d'un étiqueteur morpho-syntaxique par transfert cross-lingue*. in *Traitement Automatique des Langues*. 2014. Marseille. 11.
103. Wisniewski, G., A.K. Singh, N. Segal, and F. Yvon. *Un corpus d'erreurs de traduction*. in *Conférence sur le Traitement Automatique des Langues Naturelles*. 2013. Sables d'Olonne, France. 8p.
104. Wisniewski, G., A.K. Singh, N. Segal, and F. Yvon. *Design and analysis of a large corpus of post-edited translations: quality estimation, failure analysis and the variability of post-edition*. in *Machine Translation Summit*. 2013. Nice, France. 117-124.
105. Wisniewski, G. and F. Yvon. *La tâche de prédiction de qualité*. in *Tralogy*. 2013. Paris, France. 1-16.
106. Wisniewski, G. and F. Yvon. *Fast large-margin learning for statistical machine translation*. in *International Conference on Intelligent Text Processing and Computational Linguistics*. 2013. Samos, Greece. 12p.

Conferences without proceedings, workshops

1. Adda, G. *L'apport de l'expertise scientifique au développement de ressources et à l'évaluation en traitement des données multimédias*. in *Séminaire DGA Traitement de l'information multimédia et fusion d'information*. 2014. Paris, France.
2. Adda-Decker, M., M. Embanga Aborobongui, L. Lamel, and A. Rialland. *Embosi: automatic alignment with segments and words and phonological mining*. in *International Conference on Bantu Languages*. 2013. Paris, France.
3. Adda-Decker, M., B. Schuppler, L. Lamel, J.A. Morales-Cordovilla, and G. Adda. *What we can learn from ASR errors about low-resourced languages: a case- study of Luxembourgish and Austrian*. in *Errors by Humans and Machines in Multimedia, Multimodal, Multilingual Data Processing*. 2013. Ermenonville, France.
4. Bredin, H., P. Bruneau, A.-P. Ta, and C. Barras. *Visualizing multimodal person recognition errors: a REPERE use case of the Camomile project*. in *Errors by Humans and Machines in multimedia, multimodal and multilingual data processing*. 2013. Ermenonville, France.
5. Kübler, N., F. Yvon, and G. Wisniewski. *Human errors and automatic errors in machine translations. What are the differences?* in *Errors by Humans and Machines in Multimedia, Multimodal, Multilingual Data Processing*. 2013. Ermenonville, France.
6. Mariani, J.-J. *Language Technologies in support of Multilingualism*. in *"Unity in Diversity: Languages for Mobility, Jobs and Active Citizenship" conference*. 2013. Vilnius, Lithuania. 2 pp.
7. Mariani, J.-J. and G. Francopoulo. *Language matrices & the language resource impact factor: a journey through the LR Landscape*. in *ELRA 18th Anniversary Workshop*. 2013. Paris.
8. Mariani, J.-J. and H. Uszkoreit. *The strategic impact of META-NET on the regional, national and international level*. in *Language Resources and Evaluation 2014*. 2014. Reykjavik, Islande. 8.
9. Max, A., A. Névéol, F. Yvon, P. Zweigenbaum, and P. Ravaud. *Traduction automatique en français des revues Cochrane*. in *1st SIG IMIA Francophone*. 2013: International Medical Informatics Association. 5p.
10. Rosset, S., D. Luzzati, C. Grouin, I. Vasilescu, M. Adda-Decker, E. Bilinski, N. Camelin, J. Kahn, C. Lailler, and L. Lamel. *Human annotation of ASR error regions: Is 'gravity' a sharable concept for human annotators?* in *Errors by Humans and Machines in Multimedia, Multimodal, Multilingual Data Processing*. 2013. Ermenonville, France.

AA
AudioAcoustics

CHRISTOPHE D'ALESSANDRO

Sound is one of the most widely used mean of human interaction and communication. Human-produced sounds (speech, music and other expressive vocalization) and human sound perception are studied in the Audio & Acoustics (AA) Group. Audio and acoustics, the sciences and technologies of sound, are studied along three main lines, corresponding to the three research themes of the group:

- Audio analysis and synthesis. This themes focuses on singing and speech analysis and synthesis, signal processing, organology and digital arts;
- Expressive prosody. This themes focuses on speech prosody, including production and perception of emotions, relationships with language and culture, and similarities between vocal expression and music;
- Sound and space. This theme focuses on sound spatialization and 3D audio, including spatial hearing, virtual audio, and room acoustics;

Sound interaction and communication are closely related other research topics in both the Human Machine Communication and the Mechanics and Energetics Departments at LIMSI. This results in several fruitful collaborations between the AA group and the TLP group (expressive prosody, prosody in dialectology), the AMI group (haptic- and visual-sound interfaces), the CPU group (sound in cognition and interaction), the AERO group (voice source, cavity-flows), and the VENISE group (virtual acoustics). Finally, N. Delprat, a member of the group, is co-leading the VIDA (Virtuality, Design and Arts) transverse action

Research activities

Topic 1 - Audio Analysis and Synthesis

***C. d'Alessandro**, N. Delprat, D. Sciamarella, L. Pointal, L. Feugère, M. Evrard, Nguyen Thi Thu Trang, Cong Than Do, O. Perrotin, S. Delalez.*

Expressive Text-to-Speech (TTS) Synthesis is studied in the context of the AND-TR project. A statistical parametric synthesizer has been developed for expressive TTS. The aim of the project is to make a "digital double" of a given character, i.e. a personalized TTS system, able to mimic a given character in video games or cinema. The AA group is working on the audio side of this project. The synthesis procedure is based on statistical modeling of a database containing expressive speech. A new objective quality evaluation method has been developed.

Another TTS project concerns the Vietnamese language. This project is in cooperation between LIMSI and Hanoi University. Parametric statistical synthesis is developed. Perceptive tests showed that the new system outperforms other Vietnamese TTS systems. The main findings of this project concern

the interaction between tones and segments, and the difficult question of prosodic phrasing in Vietnamese TTS.

Performative speech synthesis, i.e. gesture controlled real-time speech synthesis is a new approach to expressive speech and voice synthesis developed at LIMSI over the past few years. Our work concerned mainly two fields: formal evaluation of the analogy between hand gestures and expressive prosody in speech and music, and gesture-controlled voice synthesizers for musical applications. Intonation stylization was studied in the present research, using "chironomy" (coming from the Greek "*cheir*" meaning "hand" and "*nomos*" meaning "rule"), i.e., the analogy between hand gestures and prosodic movements.

The ability of using handwriting gestures for controlling singing intonation (chironomic singing synthesis) was studied. Our recent results showed that chironomic singing ("drawing melodies") and real singing are comparable in terms of precision and accuracy. The "Chorus Digitalis", a choir of synthetic singing synthesizers was developed. In the field of Human Computer Interaction, we designed and tested algorithms for automatic intonation correction. The aim is to assist the musician for playing musical notes with accuracy, using a continuous control of intonation.

This work has been disseminated to the computer music community, in the Cantor Digitalis project and associated web site and discussion list.

Voice source and signal analysis methods for analysis of expressive speech are developed. We are developing toolboxes for analyzing voice source parameters using different methods like the ZZT, Lines of Maximum Amplitude of the Wavelet transform, and periodic-aperiodic decompositions. In the framework of the STIC-AMsud program "modeling voice production", we worked on the functioning of vocal folds and ventricular bands using models and numerical simulations. The question of voice radiation in the 3D acoustic space has also been studied.

In collaboration with the AERO group, we continue our signal-based approach to mode frequency prediction in compressible cavity-flows. This has been applied to spectral data of various incompressible cavity-flows and the coupling between non-linear interactions and modulation mechanisms has been investigated. Additional connections between low-frequency modulations and mode competitions have been highlighted with the help of time-frequency analyses at different locations in the cavity.

The art/science works developed in the AA group (sonic art and virtual materiality) are presented in the VIDA section of this report.

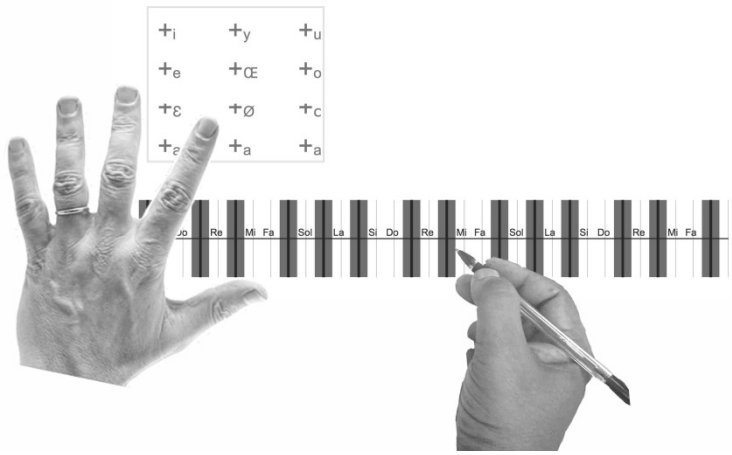


Figure 1. Bi-manual control of the vocalic color (chosen in the 2-D rectangle space with the finger position of the non-preferred hand) and the pitch (controlled with the preferred hand by the pen position along the X-dimension).

Topic 2 - Expressive Prosody

A. *Rilliard*, *Nguyen Thi Thu Trang, M. Evrard, Cong Than Do, C. Émond, V. Kozhevina, D. Doukhan, A. Pavard*

The theme focuses on describing prosodic variation in speech, under its perceptual and acoustical aspects: observing different sources of variation, detailing the changes they induce in prosodic parameters, and the influence they have on perception.

Perception paradigms. To evaluate the importance of the perceived changes observed in prosody, dedicated perception paradigm have to be set up – that control what kind of information is presented, and to propose adequate response scheme for the subject, in accordance with their proficiency in interpreting specific prosodic meaning. Advances have been made in measuring differences in prosodic decoding for social affects, allowing label-independent measure across cultures, or with illiterate children. Others paradigms are developed to analyse the relative effects of cultural background and prosodic expressivity in perceiving various dimensions of prosodic expressivity, in relation with dedicated recording paradigms.

Controlled cross-linguistic corpus recording. Affects are notably expressed through voice, and may be differentially modulated according to the cultural and linguistic background of the speakers. To investigate the role of various factors such as cultural background, gender, concepts and communication situation in individual expressive performances, a controlled recording paradigm has been set-up and tested in 5 languages (Japanese, USA English, France's French, Brazilian Portuguese, German), and with L1 and L2 speakers. About 70 speakers have been recorded in detailed and reproducible communication situations. Their prosodic and facial expressivity is recorded and currently analysed to have a better understanding of the influence of these various factors. The data is particularly suitable for foreign language teaching.

Role of modalities. Multimodality lies at the centre of face-to-face expressive communication. Smiles are expressed by lips and eyes but also perceived in voice. What makes a voice sound smiling? What kinds of smiles are transmitted through speech? Which communicative functions do they perform? These questions are under scrutiny, building on findings based on spontaneous speech. We are trying to

reproduce the expressivity under controlled condition to allow acoustical and visual analysis and answer questions raised by naturally occurring expressions with regards to findings reported in the literature. Preceding works on Brazilian Portuguese on multimodal expressions have shown that the more linguistic communicative functions are, the more speech governs their expression, while more social interactions are mainly governed by facial cues.

Acoustic measures for prosodic changes. These recorded and perceived prosodic changes have to be described at an acoustic level. In collaboration with the "Audio Analysis and Synthesis" theme, acoustic measurements of various prosodic parameters are made. Their importance for perception is investigated thanks to speech synthesis or resynthesis tools. These works allow for the development of a better understanding of expressive dimensions in voice. Application of some of these measures to the objective description of dialectal prosody is also continued in order to develop further the notion of geoprosody.

Topic 3 - Sound and Space

__B. Katz__, L. Pointal, P. Luizard, C. André (U. Liège), M. Aussal (Digital Media Solutions), D. Poirier-Quinot (EADS-Astrium), F. Rugeles (Orange), B Postma, L. Simon, A. Andreopoulou, J. Mathew, L. Simon, A. Andreopoulou.

The Sound & Space team is concerned with various aspects of the spatial nature of sound fields around a listener. These aspects are primarily centered on the creation of immersive auditory interfaces using 3D audio. As such, there is a strong interest in spatial auditory perception (spatial hearing) and virtual reality. In addition, a third line of research focusses on aspects of room acoustics, both in terms of measurement and characterization, as the need for realistic room simulations and understanding of spatial perception in rooms are key elements of the first two main topics.

During the past two years, several major studies have been completed. The first concerns the evaluation of spatial cognition in virtual room acoustic simulations for visually impaired individuals. Our studies have shown that the use of dynamic navigation with interactive audio feedback, such as footfall and finger-snap noise, allow individuals to have a comparable understanding of a given architectural space when compared to real navigation. Results far exceeded those obtained through passive navigation, even with spatial 3d rendering. The second concerns a series of investigations of congruence between audio and visual renderings. One group of studies examined the effect of spatial distortions, such a fish-eye lenses and a proposed spatial audio equivalent. The second group examined spatial congruence in high precision 3d audio and visual renderings in the context of 3d stereoscopic cinema applications where individuals can be situated at various distances from the ideal observation point.

In collaboration with the VENISE and AMI groups, a number of studies have continued regarding the combination or interaction between audio and haptic renderings in the context of abstract data exploration and navigation. These studies have shown the added benefit of spatial audio for improving localized haptic exploration. Additional studies have further explored the design of feedback metaphors that provide cross-modal support an understanding between vibro-tactile and acoustic signals.

In the context of the FUI project BiLi (Binaural Listening), which unites numerous research, SME, and production houses working towards the development and general public application of spatial audio, efforts are underway to improve our understanding of the limitations of spatial hearing precision as well as to improve the quality of spatial audio renderings. These efforts have employed numerous perceptual, analytical, and computational studies.

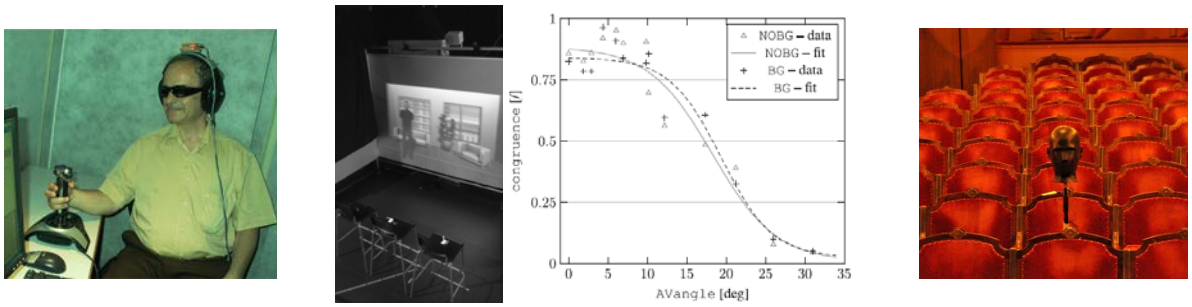


Figure 2. Spatial cognition evaluation through navigation in virtual architecture (left). Perceptual limits of audio-visual congruence detection (center). Acoustical studies of theatres for calibration of historic simulations (right).

Investigations into the spatial aspects of room acoustics, aside from the studies with the visually impaired, have focused on two principal directions. The first concerns a series of studies on coupled volume systems, where two volumes are connected and we are able to perceive a combination of the acoustics of both spaces. This type of system is found in virtual architecture explorations as well as in a number of modern performing arts hall designs. We have been investigating this acoustic coupled system in terms of physical properties, numerical simulations, and finally perceptual studies. The second direction is related to the recently accepted ANR-ECHO project which concerns the use of virtual acoustic architecture simulations as a tool for aiding historical research. In particular, the ECHO project addresses the evolution of the theatre over the 20th century, including the addition of amplification system, through the creating of calibrated historical simulation models of several historic theatres in Paris over the course of the studied period.

Highlights

Virtual acoustic architectural simulations for spatial cognition. The capacity for virtual acoustic simulations to provide sufficient acoustic cues for the creation of spatial mental maps of architectural spaces for visually impaired users was validated, allowing for off-site learning of new spaces, a real benefit to visually impaired individuals.

Cantor Digitalis. The Cantor Digitalis performative synthesis software has been released under a CECILL license (cantordigitali.limsi.fr). This -time digital singer is raising a growing interest in the computer music community.

Staff

Permanent staff

Last name	First Name	Position	Employer	HDR	Group
d'Alessandro	Christophe	DR2	CNRS	HDR	AA
Delprat	Nathalie	MC	UPMC		AA
Katz	Brian	CR1	CNRS	HDR	AA
Pointal	Laurent	IE1C	CNRS		AA/AMI
Rilliard	Albert	CR1	CNRS	HDR	AA
Sciamarella	Denisse	CR1	CNRS		AERO/AA

PhD Students

Last name	First name	Arrival date	Thesis defense	School / University
Aussal	Matthieu	01/10/2011	02/10/2014	UPMC
Delalez	Samuel	01/10/2014		Université Paris-Sud
Doukhan	David	01/10/2009	20/09/2013	Université Paris-Sud
Evrard	Marc	01/01/2012		Université Paris-Sud
Feugère	Lionel	01/12/2009	26/09/2013	UPMC
Luizard	Paul	01/10/2010	16/09/2013	UPMC
Mathew	Justin	01/10/2014		Université Paris-Sud
Nguyen	Thi Thu Trang	01/09/2010		Université Paris-Sud
Perrotin	Olivier	01/10/2012		Université Paris-Sud
Poirier-Quinot	David	15/10/2011		UPMC
Postma	Barteld	01/01/2014		Université Paris-Sud
Rugeles Ospina	Felipe Enrique	01/11/2012		UPMC

Non permanent staff

Last name	First Name	Contact	Employer	From	To
Andreopoulou	Areti	CDD	CNRS	01/02/2014	31/01/2015
Do	Cong Thanh	CDD	CNRS	01/05/2013	30/06/2013
Do	Cong Thanh	CDD	CNRS	01/07/2013	30/09/2014
Emond	Caroline	Bourse postdoc	RCRSH (Canada)	16/09/2014	30/04/2016
Feugère	Lionel	ATER	UPMC	01/09/2013	30/07/2014
Guerry	Marine	IE	CNRS	03/03/2014	31/08/2014
Kozhevina	Varvara	CDD IE	CNRS	01/03/2014	14/12/2014
Luizard	Paul	CDD IE	Université Paris-Sud	01/10/2013	30/11/2013
Simon	Laurent S. R.	CDD Chercheur	CNRS	01/11/2013	31/10/2015

Internships

First Name	Name	From	To	Prepared degree	School / University
Alexander	**Fox**	02/09/2013	28/02/2014	Master	Université de Sydney
Daniel	**Furlan**	01/09/2014	28/11/2014	Ingénieur	ENSAM Paris
Thomas	**Ibanez**	01/04/2014	01/09/2014	Master 2 Ergonomie	Université Paris Descartes
Prune	**Irolla**	03/03/2014	01/08/2014	Ingénieur	INP Grenoble
Simon	**Jacquin**	10/03/2014	25/07/2014	Ingénieur	ENSIMAG
Renaud	**Leblanc-Guindon**	28/01/2013	26/04/2013	3^{e} Année Ingénieur	E.P.F.
Frédéric	**Lepoutre**	17/06/2013	30/08/2013	Ingénieur 2^{e} année	ENSEA
Maxime	**Letellier**	03/03/2014	31/07/2014	Ingénieur	ENSEA
Hanna	**Matahri**	16/04/2014	21/05/2014	Master son	ENS Louis Lumière
Robin	**Morier**	23/06/2014	31/08/2014	DUT informatique	IUT Orsay

Indicators of scientific notoriety

Prizes and awards

- C. d'Alessandro has been awarded "5 diapason" by the musical magazine Diapason for his Organ and Augmented Reality CD Hortus 096, in February 2013.

Editorial activities

- C. d'Alessandro is an Associate Editor of the EURASIP Journal on Speech Audio and Music Processing,
- C. d'Alessandro is a member of the editorial board of the Journal of Speech Sciences.
- C. d'Alessandro is a member of the editorial board of the electronic journal Musimédiane (musicology)
- C. d'Alessandro is a member of the editorial board of the electronic "carnet de recherche Science et Voix"
- A. Rilliard is a member of the editorial board of the Journal of Speech Sciences.
- B. Katz is an Associate Editor, Springer: Journal of Multimodal Interfaces (JMUI), since 2014.
- B. Katz is an Associate Editor: IEICE Transactions on fundamentals of Electronics, Communications, and Computer Sciences, since 2014.

Invited lectures, talks or seminars

- A. Rilliard, « Affective Prosody: Measures & Stylisation », Prosody School, Federal University of Campinas, SP, Brazil, 24-30/08/2014.
- Katz, « Virtual Auditory Display Architecture and the Blind », RIEC International Symposium on Perception and Communication, Sendai, Japan, 24-juillet-2014.
- Katz, « L'Acoustique des Salles et La Voix », Stage de Formation « l'Acoustique Musicale », La Grange-au-Lac, 13octobre-2014.

Participation in expertise and administration of research

- B. Katz, Project Reviewer : Agence National de la Recherhce (ANR), Austrian Science Fund (FWF), Mairie de Paris (Paris 2030).
- C. d'Alessandro, chairman of the AERES committee UMR STMS N°9912, vague 2013, reviewer for ANR, member of Historical Monument Committee, Ministry of Culture and Communication.

Ph.D and Habilitation committees

- B.Katz, participated in 5 Ph.D committees (opponent, Finland, examiner, Belgium, examiner, supervisor, reviewer).
- C. d'Alessandro participated in 6 PhD (reviewer, examiner, supervisor) and 2 Habilitation committee (examiner, supervisor).

Dissemination and scientific outreach

- Cantor Digitalis, performative digital singer, software released under a CECILL license.
- Participation to the Sciences festival in Orsay, 2013, 2014.
- Art/science performances (digital choir: Chorus Digitalis, augmented piano : Wired Harmony)

Research conventions and contracts

Starting date	Ending date	Acronym	Category	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
15/12/10	30/11/14	PADE	Collaboration de recherche	ANR	Rilliard Albert	Rilliard Albert	National	163 513	JCJC
01/01/14	30/06/17	ChaNTeR	Collaboration de recherche	ANR	d'Alessandro Christophe	d'Alessandro Christophe	National	248 082	CONTINT
01/01/14	30/06/17	ECHO	Collaboration de recherche	ANR	Mervant-Roux Marie-Madeleine	Katz Brian	National	167 564	CULT
01/08/12	30/07/16	BiLi	Collaboration de recherche	OSEO	Parmentier Matthieu	Katz Brian	National	392 000	Pôle de compétitivité
01/10/11	31/03/15	ADN-TR	Collaboration de recherche	Région Ile de France	Guiard Cédric	Martin Jean-Claude	National	531 140	Pôle de compétitivité
02/02/12	31/01/15		Collaboration de recherche	ASTRIUM	Katz Brian	Katz Brian	Industriel	39 600	CIFRE
01/10/11	30/09/14		Collaboration de recherche	DMS	Katz Brian	Katz Brian	Industriel	15 000	CIFRE
02/11/12	01/11/15	co-encadrement de thèse	Collaboration de recherche	Orange Labs	Katz Brian	Katz Brian	Industriel	27 547	
11/08/14	10/02/16	SSESS	Collaboration de recherche	3D Sound Labs	Katz Brian	Katz Brian	Industriel	10 800	
10/03/11	01/10/11		Accord de secret	DMS	Katz Brian	Katz Brian	Industriel	-	Autre
01/02/09	31/01/14	Technologies acoustiques	Accord de secret	Sonic Emotion	Katz Brian	Katz Brian	Industriel	-	Autre

Valorization

Patents, software, licence agreements…

Patent	LIMSI Author	Co-owner	Date	Comment
Method of assisting in the location of a person in distress via their mobile phone	Katz Brian	Astrium EADS	01/10/2014	Results of CIFRE PhD in collaboration with Astrium

Scientific publications

Doctoral theses and HdR

1. Feugère, L., *Synthèse par règles de la voix chantée contrôlée par le geste et applications musicales* 2013, thèse de l'UPMC. Soutenue à Orsay, France, le 26 septembre 2013, 236p p.
2. Luizard, P., *Les espaces couplés : comportement, conception et perception dans un contexte de salle de spectacle* 2013, thèse de l'UPMC. Soutenue à Paris, France, le 16 septembre 2013, 188p p.
3. Rilliard, A., *Prosodie et Interaction Homme-Machine : Étude de la variation démarcative, diatopique, diachronique & expressive*, 2014, HdR Université Paris-Sud, soutenue à LIMSI-CNRS, Orsay, France, le 31/10/2014. 165 p.

Articles in peer reviewed scientific journals

1. Ammi, M. and B. Katz, *Intermodal audio-haptic metaphor: Improvement of target search in abstract environments.* International Journal of Human-Computer Interaction, 2014. **30** (11): pp.921-933.
2. André, C., E. Corteel, J.-J. Embrechts, J.G. Verly, and B. Katz, *Subjective evaluation of the audiovisual spatial congruence in the case of stereoscopic-3D video and wave field synthesis.* International Journal of Human-Computer Studies, 2014. **72** (1): pp.23-32.
3. Basley, J., L. Pastur, N. Delprat, and F. Lusseyran, *Space-time aspects of a three-dimensional multi-modulated open cavity flow.* Physics of Fluids, 2013. **25** (6): pp.064105_1-064105_26.
4. Basley, J., L. Pastur, F. Lusseyran, J. Soria, and N. Delprat, *On the modulating effect of three-dimensional instabilities in open cavity flows.* Journal of Fluid Mechanics, 2014. **759**: pp.546-578.
5. Bouchara, T., C. Jacquemin, and B. Katz, *Cueing multimedia search with audio-visual blur.* ACM Transactions on Applied Perception, 2013. **10** (2): pp.7_1-7_21.
6. d'Alessandro, C., *Synthèse de la parole.* L'information grammaticale, 2014. (141): pp.31-36.
7. d'Alessandro, C., L. Feugère, S. Le Beux, O. Perrotin, and A. Rilliard, *Drawing melodies: Evaluation of chironomic singing synthesis.* Journal of the Acoustical Society of America, 2014. **135** (6): pp.3601-3612.
8. Delprat, N., *Walking clouds and Augmented Reverie.* Leonardo Journal, 2014. **47** (1): pp.68-69.
9. Delprat, N. and C. Jacquemin, *VIDA - Une thématique art-science dans un laboratoire de recherche scientifique.* Technique et Science Informatiques, 2013. **32** (3-4): pp.499-502.
10. Katz, B. and P. Luizard, *Investigation of the effective aperture area of sliding and hinged doors between coupled spaces.* Journal of the Acoustical Society of America, 2014. **136** (2): pp.EL135-EL141.
11. Katz, B. and M. Noisternig, *A comparative study of interaural time delay estimation methods.* Journal of the Acoustical Society of America, 2014. **135** (6): pp.3530-3540.
12. Lu, Y., V. Aubergé, A. Rilliard, and W. Gu, Journal of the School of Chinese Language and Culture, Nanjing Normal University, 2013. **3**: pp.169-174.
13. Luizard, P., J.-D. Polack, and B. Katz, *Sound energy decay in coupled spaces using a parametric analytical solution of a diffusion equation.* Journal of the Acoustical Society of America, 2014. **135**: pp.2765-2776.
14. Menelas, B., L. Picinali, P. Bourdot, and B. Katz, *Non-visual identification, localization, and selection of entities of interest in a 3D environment.* Journal on Multimodal User Interfaces, 2014. pp.1-14.
15. Parseihian, G., C. Jouffrais, and B. Katz, *Reaching nearby sources: comparison between real and virtual sound and visual targets.* Frontiers in Neuroscience, 2014. **8**: pp.269:1-13.
16. Picinali, L., A. Afonso, M. Denis, and B. Katz, *Exploration of architectural spaces by the Blind using virtual auditory reality for the construction of spatial knowledge.* International Journal of Human-Computer Studies, 2014. **72** (4): pp.393-407.
17. Rilliard, A., J.A. de Moraes, D. Erickson, and T. Shochi, *Social affect production and perception across languages and cultures – the role of prosody.* Leitura, 2013. **2** (52): pp.15-41.

Books & chapters in books

1. d'Alessandro, C. and G. Richard, *Synthèse de la parole à partir du texte*, in *Techniques de l'ingénieur,* 2013, Edition Techniques de l'ingénieur. pp. 27.
2. de Moraes, J.A. and A. Rilliard, *Illocution, attitudes and prosody: A multimodal analysis*, in *Spoken Corpora and Linguistic Studies*, Tommaso Raso and Heliana Ribeiro De Mello, Eds. 2014, John Benjamins Publishing Company. pp. 233-270.
3. Delprat, N., *Walking clouds and Augmented Reverie*, in *Water is in the air: physics, politics, and poetics of water*, Bureaud Annick, Editor. 2014, Leonardo/ISAST MIT Press. pp. 2p.
4. Rilliard, A., D. Erickson, J.A. de Moraes, and T. Shochi, *Cross-cultural perception of some Japanese politeness and impoliteness expressions*, in *Linguistic approaches to emotions in context*, Baider Fabienne and Cislaru Georgeta, Eds. 2014, John Benjamins Publishing Company. pp. 251-276.

Conferences with proceedings and review committee

1. André, C., E. Corteel, J.-J. Embrechts, J.G. Verly, and B. Katz. *A new validated method for improving the audiovisual spatial congruence in the case of stereoscopic-3D video andwave field synthesis*. in *3D Stereo MEDIA*. 2013. Liège, Belgique. 1-8.
2. Andreopoulou, A. and Roginska, *Evaluating HRTF Similarity through Subjective Assessments: Factors that can Affect Judgment.* Joined ICMC | SCM 2014 conference, 2014. pp.1375-1381.
3. Aussal, M., F. Alouges, and B. Katz. *A study of spherical harmonics interpolation for HRTF exchange*. in *International Congress on Acoustics*. 2013. Montreal, Canada. 050010_1-050010_9.
4. Boula De Mareüil, P., A. Rilliard, and F. Ivent. *Une étude prosodique comparative des questions en français en contact avec l'occitan*. in *Journées d'Etude sur la Parole*. 2014. Le Mans. 10.
5. Boula De Mareüil, P., A. Rilliard, I. Lehka-Lemarchand, and F. Ivent. *Regional accents and languages in France: a contrastive prosodic analysis of Romance varieties*. in *Workshop on Phonetics, Phonology and Languages in Contact (PPLC 2013)*. 2013: ISCA. 72-75.
6. Delprat, N. *Temporalités du virtuel et réalités du corps: de l'être nuageux aux doubles de Narcisse*. in *Colloque International sur le Sujet Digital*. 2014. Paris, France.
7. Do, C.-T., M. Evrard, A. Leman, C. d'Alessandro, A. Rilliard, and J.-L. Crebouw. *Objective evaluation of HMM-based speech synthesis system using Kullback-Leibler divergence*. 2014. Singapour. 5.
8. Feugère, L. and C. d'Alessandro. *Digitartic: bi-manual gestural control of articulation in performative singing synthesis*. in *International Conference on New Interfaces for Musical Expression*. 2013. Daejon, Korea: Woon Seung Yeo, Kyogu Lee, Alexander Sigman, Haru Ji, Graham Wakefield. 331-336.
9. Feugère, L. and C. d'Alessandro. *Rule-Based performative synthesis of sung syllables*. in *International Conference on New Interfaces for Musical Expression*. 2014. London: Caramiaux, Baptiste and Tahiroglu, Koray and Fiebrink, Rebecca and Tanaka, Atau. 86-87.
10. Feugère, L., C. d'Alessandro, and B. Doval. *Performative voice synthesis for edutainment in acoustic phonetics and singing: a case study using the Cantor Digitalis*. in *International Conference on Intelligent Technologies for Interactive Entertainment*. 2013. Mons, Belgium: Matei Mancas, Nicolas d' Alessandro, Xavier Siebert, Bernard Gosselin, Carlos Valderrama, Thierry Dutoit. 169-178.
11. Garcia, D.P., M. Rychtáriková, C. Glorieux, and B. Katz. *Interactive auralization of self-generated oral sounds in virtual acoustic environments for research in human echolocation*. in Forum Acusticum. 2014. Krakow, Poland. 6.
12. Katz, B., M. Noisternig, and O. Delarozière. *Scale model auralization for a*rt science and music: the stupaphonic experiment. in EAA Joint Symposium on Auralization and Ambisonics. 2014. Berlin, Germany. 14-19.
13. Lu, Y., V. Aubergé, N. Audibert, and A. Rilliard. *Audiovisual Perception of Expressions of Mandarin Chinese social affects by French L2 Learners*. in *7th international conference on Speech Prosody*. 2014. Dublin, Ireland. 169-173.
14. Lu, Y., V. Aubergé, and A. Rilliard. *Cognitive distance of attitudes in Chinese and French*. in *Workshop on Affective Social Speech Signals (WASSS 2013)*. 2013: ISCA. 5p.
15. Lu, Y., V. Aubergé, and A. Rilliard. *Prosodic profiles of social affects in mandarin chinese*. in *International Conference on Speech Prosody*. 2014. Dublin, Ireland. 125-129.
16. Luizard, P., B. Katz, and C. Guastavino. *Perception of reverberation in coupled volumes: discrimination and suitability*. in *International Symposium on Room Acoustics*. 2013. Toronto, Canada. 1-9.
17. Luizard, P., M. Otani, J. Botts, L. Savioja, and B. Katz. *Comparison of sound field measurements and predictions in coupled volumes between numerical methods and scale model measurements*. in *International Congress on Acoustics*. 2013. Montreal, Canada. 015114_1-015114_9.
18. Luizard, P., J.-D. Polack, and B. Katz. *Auralization of coupled spaces based on a diffusion equation model*. in *Sound and Music Computing Conference*. 2013. Stockholm, Sweden. 616-621.
19. Nguyen, T.T.T., A. Rilliard, D.D. Tran, and C. d'Alessandro. *Prosodic phrasing modeling for Vietnamese TTS using syntactic information*. in *Annual Conference of the International Speech Communication Association*. 2014. Singapore, Singapore. 2332-2336.
20. Nguyen, T.T.T., A. Rilliard, D.D. Tran, C. d'Alessandro, and T.N.Y. Pham. *Intonation issues in HMM-based speech synthesis for Vietnamese*. in *International Workshop on Spoken Languages Technologies for Under-resourced languages*. 2014. St Petersburg, Russia. 98-104.

21. Nicol, R., L. Gros, C. Colomes, O. Warusfel, M. Noisternig, H. Bahu, L.S.R. Simon, and B. Katz. *A roadmap for assessing the quality of experience of 3D audio binaural rendering*. in *EAA Joint Symposium on Auralization and Ambisonics*. 2014. Berlin, Germany. 100-106.
22. Perrotin, O. and C. d'Alessandro. *Adaptive mapping for improved pitch accuracy on touch user interfaces*. in *International Conference on New Interfaces for Musical Expression*. 2013. Daejeon, Korea: Woon Seung Yeo, Kyogu Lee, Alexander Sigman, Haru Ji, Graham Wakefield. 186-189.
23. Perrotin, O. and C. d'Alessandro. *Visualizing gestures in the control of a digital musical instrument*. in *Proceedings of the International Conference on New Interfaces for Musical Expression*. 2014. London, United Kingdom. 605-608.
24. Poirier-Quinot, D. and B. F.G. Katz. *CAVE-based virtual prototyping of an audio radiogoniometer: ecological validity assessment*. in *International Conference on Auditory Display*. 2014. New York, USA. 8.
25. Poirier-Quinot, D. and B. Katz. *BlenderCAVE: A multimodal scene graph editor for virtual reality*. in *International Conference on Auditory Display*. 2013. Lodz, Poland. 223-230.
26. Poirier-Quinot, D., D. Touraine, and B. Katz. *BlenderCAVE: a flexible opensource authoring tool dedicated to multimodal virtual reality*. in *Joint Virtual Reality Conference of* EuroVR - EGVE - VEC. 2013. Orsay, France. 19-22.
27. Postma, B. and B. Katz. *A History of the Use of Reflections Arrival Time in Pre-Sabinian Concert Hall Design*. in *Forum Acusticum*. 2014. Krakow, Poland. 6.
28. Rilliard, A., J.A. de Moraes, T. Shochi, and D. Erickson. *Perception of emotions across sentence's mode in Brazilian Portuguese*. in *Workshop on Affective Social Speech Signals (WASSS 2013)*. 2013: ISCA. 4p.
29. Rilliard, A., D. Erickson, T. Shochi, and J.A. de Moraes. *Social face to face communication – American English attitudinal prosody*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 1648-1652.
30. Rilliard, A., D. Erickson, T. Shochi, and J.A. de Moraes. *US English attitudinal prosody performances in L1 and L2 speakers*. in *International Conference on Speech Prosody*. 2014. Dublin, Ireland. 895-899.
31. Rugeles, F., M. Emerit, and B. Katz. *Evaluation objective et subjective de différentes méthodes de lissage des HRTF*. in *Congrès Français d'Acoustique*. 2014. Poitiers, France. 2215-2221.
32. Shochi, T., D. Erickson, A. Rilliard, and J.A. de Moraes. *Prosodic differences between L1 and L2 performance in social face to face American English context*. in *Workshop on Affective Social Speech Signals (WASSS 2013)*. 2013: ISCA. 5p.
33. Simon, L.S.R., F. Nouviale, R. Gaugne, and V. Gouranton. *Sonic interaction with a virtual orchestra of factory machinery*. in *Sonic Interaction for Virtual Environments*. 2014: IEEE. 6.

Conferences without proceedings, workshops

1. d'Alessandro, N., C. d'Alessandro, L. Feugère, M. Astrinaki, J. Wang, O. Perrotin, A. Pon, and B. Doval. *Vox Tactum Meets Chorus Digitalis: Seven Years of Singing Surfaces*. in *International Conference on New Interfaces for Musical Expression*. 2013. Daejeon, Korea.
2. Delprat, N. *Art et Science*. 2014. Université Pierre et Marie Curie.
3. Feugère, L., O. Perrotin, C. d'Alessandro, and B. Doval. *Concert Chorus Digitalis - Saison 3.0*. in *Journées nationales du Développement Logiciel*. 2013. Palaiseau, France.

AMI
Architectures and Models for Interaction

YACINE BELLIK

The emergence in recent years of new classes of users, new software and hardware platforms and new interaction environments and contexts (mobility) has shifted our attention from static interaction situations to open and dynamic ones. Indeed, users of current computer systems are now mainly “ordinary people” who may need to interact with a digital system anywhere and at any time. They generally have only a limited knowledge of how their computers work, but they expect that their devices will learn to recognize and anticipate upon their on-going and constantly changing needs. This is the reason why the AMI group focuses on post-WIMP interaction paradigms where the hands on experience of the physical world is important, such as tangible user interfaces to manipulate physical objects, tactile surfaces, or 3D interactions. Besides, ambient environments and augmented reality spaces provide the designers of new interfaces with new modalities and new requirements, thus enriching the traditional issues in multimodal interfaces.

AMI is composed of people trained in various interaction modalities such as vision, tactile and haptic interaction as well as in multimodal interfaces that combines different modalities to achieve “natural” interaction. Because of this wide range of competencies, AMI cooperates widely, both inside LIMSI with other teams in both departments and externally, with industrial and scientific partners in Digiteo and other national and international research frameworks.

During the period, two AMI members have left the group: the previous head (J.P. Sansonnet) retired and one of AMI’s professors (N. Sabouret) changed group and joined the CPU team. These departures were counterbalanced by the recruitment of two assistant professors (F. Bimbard and M. Gouiffès) from the ACCIS team in the IEF laboratory at University Paris-Sud. Through these changes, Human/Computer interaction has become a primary research focus for AMI research group, as described in the following four closely-related topics:

- Topic *« Image and interaction »* deals with image processing for augmented reality and robot vision. It is an area where the relationship between data processing and acting in the world is particularly important.
- Topic *« Ambient and interaction »* deals with new interaction issues within the context of ambient environments: spatial interaction, augmented reality within ambient environments, task assistance and supervision. It is where we think we can gain empirical evidence on how virtual and physical objects can be combined in order to produce meaningful experiences for helping people understand the future world in which they will live and to assist them in their daily tasks.
- Topic *« Haptic interaction and communication »* deals with the characterization of abstract environments, collaborative and emotional haptics. It also provides us with a test-bed for questions concerning the construction of mutual trust and confidence when learning to do new things together.
- Topic *« Interaction on tactile surfaces »* deals with problems where the use of a large tactile surface makes more sense and provide more benefits than the traditional mouse+keyboard+screen triple. This is the case, for instance, in the fields of multi-dimensional temporal data visualization and urban planning where there is a need for

planners and politic decision makers to have collaborative and highly interactive tools to envision new cities.

Research activities

Topic 1: Image and Interaction

E. Frenoux, D. Béroule, F. Bimbard, H. Ding, M. Gouiffès, C. Jacquemin, A. Setkov, PA Bokaris.

The theme "Image and Interaction" gathers several research fields concerning augmented reality, computer vision and arts-sciences. Each of them aims at developing new technologies in automatic processing of digital images and human visual interaction improvement. The problems addressed in this theme are:

- Use of physics related to vision, camera-projector systems: geometric and colorimetric characterization, color invariance, use of the Human Visual System properties.
- Scene analysis: 1) detection of saliencies, robust features, color, texture, features points and regions, 2) Spatial and temporal matching, tracking, 3) 3D Reconstruction, 4) scene recognition (collaboration with CPU team, P. Tarroux)
- Rendering: geometric and colorimetric adaptation, shaders for real-time calibration, adaptation, and interaction with moving targets or moving cameras.
- Acceleration of the algorithms, Graphic Processing Unit (GPU) programming.

Image processing for Augmented Reality

For Projector-based Augmented Reality (i.e. using video-projection to overlay physical space with visual digital data), it is necessary to calibrate the image projected onto the physical world, to find its optimal position. In addition to the core calibration issues, Projector-based Augmented Reality raises many challenges in image processing such as:

- Computing projection masks so that visual augmentation can be limited to subsets of a realscene (e.g. spectators shadows);
- Real-time image transformation to re-project it onto the scene, after modification (e.g. contour delineation);
- Human-scene interaction management.

All the algorithms are implemented on the GPU in order to optimize processing time and make them compatible with real-time interaction. Calibration allows rebuilding the physical world geometry and uses it for computing image correction on plane parts of the physical scene. Concerning calibration and real-time images compensation, a research collaboration has been developed with the IEF lab (team ACCIS), which was materialized at the end of 2012 by the beginning of Alex Setkov PhD, and the integration of two members (Michèle Gouiffès and Franck Bimbard) of ACCIS in our laboratory. Two projects proposals have been made on this topics: 1) "ANR blanc bilateral" project has been submitted in January 2013, in collaboration with Germany (HU and TUC universities), 2) a Digiteo project "Post-doctorant" (a collaboration with F. Vernier, AMI, and C. Clavel CPU).

Since a few years, cameras and projectors are widely used and are integrated to many electronic devices (smartphones, pico-projectors). Thus, we can now use these technologies in Projector-based Augmented Reality applications. Knowing that the pin-hole model can be applied both to projectors and cameras, we can use these two kinds of devices for 3D reconstruction and 3D tracking. To do so, we have to calibrate the devices. For this purpose, we are working on the following two problems:

- Calibration of cameras and projectors using seen and projected calibration grids;
- Self-calibration of cameras and projectors only based on correspondences between seen and projected images.

As calibration algorithms are widely used and developed since many years for cameras, we are working on projectors calibration, which requires new image processing algorithms to be reliable despite the physical problems inherent to these devices (luminosity …). Once the calibration is done, we can compute 3D reconstruction by using classical algorithms based, for example, on the essential matrix. In addition, we optimize and/or adapt the previous algorithms for several architectures such as CPU/SIMD and GPGPU. This point is really important in order to be able to use these algorithms in real-time applications. Our researches concerning Projector-based Augmented Reality are used in various projects: for built heritage augmentation, for interactive installations in public spaces, and more generally, for some of the art/science applications described in VIDA transversal theme. 204 AMI group LIMSI – Scientific report 2013. Five PhD students worked on applications and extensions of image processing for Augmented Reality: Hui Ding has studied audio-graphic scenes descriptions and rendering in the framework of the ANR Topophonie project (PhD defense in 2013 and ATER in 2013-2014). Her results can be applied to audio and visual augmentations of physical scenes. Tifanie Bouchara has developed comparative analysis methods for visual and auditory perceptions in audio-graphic scenes (post-doctoral position in 2013-2014). Sarah Fdili Alaoui PhD has proposed new perspectives for gesture interaction using the whole body and motion analysis in collaboration with IRCAM (post-doctoral position in 2013-2014). Alexander Setkov has started his PhD in 2012. He is currently working on geometric image distortion compensation through color and geometric invariance for feature matching applied to camera-projector systems. He stayed 6 months in 2014 at Computer Vision Center in University Autonomia de Barcelona and since his return, a collaboration with this laboratory has been developed. Panagiotis-Alexandros Bokaris started his PhD in 2013. His PhD is supervised in collaboration with LadHyX-CNRS at Ecole polytechnique and Laboratoire Victor Vérité, a theater company. His research is on color compensation in camera-projector system for the concealement of human presence for the stage. His first work is on color compensation through real-time and adaptative techniques, it will develop further to take mobile scenes in consideration. Through his collaboration with LadHyX he works on presence revelation.

Image Processing and Robotic Vision

This theme is the object of collaboration with members of the CPU group of the LIMSI (detailed in Topic 1 of CPU group presentation). The PhDs and following researches of Ahmad Hasasneh and Mathieu Dubois concerned the development of machine learning methods for semantic place recognition and robot localization. Both PhD have been defended in 2012, and researches concerning these topics continue through a collaboration with Philippe Tarroux (CPU). As a consequence of these works and to prepare new research topics in this area, several members of the group were involved in the creation of Digicosme Working Group “deepnets”.

Detecting saliencies in images sequences

HDRI (High Dynamic Range Imaging) techniques are used to produce dynamic and well-contrasted images of real-world luminance, by capturing several images of the same scene through exposure bracketing. In the same vein, we have developed a new approach to image fusion from a series of photographs of the same scene taken at different timestamps. When compared with HDRI, exposure bracketing at a single timestamp is replaced by timestamp variation disregarding exposure times. Because of the parallel between these two approaches, this technique is called HTRI (High Time Range Imaging), it aims at capturing ephemeral events occurring over a long time period during which a sequence of images is shot. For each pixel location, the most salient colors are privileged in the series of photographs. The choice of the saliency criterion is based on an analysis of the existing admitted definitions of visual attention. In a second stage, a higher priority is assigned to the pixels with high temporal saliency, i.e., which appear very briefly in the sequence, jointly producing spatial and temporal changes of contrast between two successive frames. The proposed algorithm captures all these salient objects in the final image, without introducing a significant amount of noise, and

despite the large illumination changes that may occur in the acquisition conditions from one frame to the next. This method has been published in a journal paper in 2013.

HTRI processing of a sequence of day and night pictures Photo © Bertrand Planes

Topic 2: Ambient and Interaction

***Y. Bellik**, D. Béroule, A. Gharsellaoui, A. Mohamed, J.P. Sansonnet*

Classical WIMP interaction models are not adequate within the context of ambient environments due to users' mobility, interaction devices heterogeneity and interaction context variability. Hence, there is a need of new interaction models that will suit well users' needs in ambient environments.

Spatial Interaction

Ambient environments aim to embed the physical environment with various sensors and effectors in order to assist users in their daily tasks. In particular, the use of location sensors allows to transform the physical space itself into a mean of interaction. For example, the simple act of bringing a tag representing a video file close to another tag representing a screen in the house, may trigger the playing of the video file on the corresponding screen. Some systems using space as a means of interaction already exist (in the context of tangible interaction), but this use is still fragmented and/or ad hoc (using proximity only for some systems, orientation for others...) and do not offer a formal and generic modeling of spatial interaction language. That is why we have launched actions to explore in depth how the physical space can be used as a means of interaction. To achieve this objective, a preliminary step is to formally define a language for the description of spatial interactions. This language should be based on the different physical spatial properties and relations between objects: position, speed, acceleration, orientation, distance, etc. This language will be used, in a second step, to implement an interactive tool for spatial interactions specification. Such an interactive tool will allow us, in a third step, to quickly implement and conduct user studies in our intelligent room platform (IRoom). These studies will allow us to explore different techniques for spatial interaction and to provide guidelines (what properties, operators to use in which case...) for spatial interaction design.

The affordance problem

An important problem that we are faced when one wants to use the space as interaction channel is the problem of affordance. Since in ambient environments it becomes possible to define certain areas of space as special places offering some services, a question then arises: how to indicate to the

user the "sensitive" areas and how to inform him/her about the services they offer? It is also possible that the simple proximity of two or more objects induces a given action on the system. How to tell the user about this kind of potential interactions between physical objects? In addition, if the induced action may vary depending, for example, on the orientation of objects, their velocities, etc., providing the user with some clues about these potential interactions becomes an even more complex problem. All these considerations lead us to exclude the use of real physical objects to identify these "ambient-spots" and their potential spatial interactions. We rather prefer to explore other approaches such as augmented reality approaches. Using Google Glass, for example, offers an interesting option to explore. We have also started to explore less intrusive methods such as using a mobile phone or a mobile pico-projector (collaboration with Image and Interaction topic) to inform the user about spatial interaction possibilities.

System Fault Detection and User Task Assistance

A great benefit of ambient environments is that they offer a large variety of sensors that can be used to monitor both system and user's actions.

However, sensors and actuators may suffer failures. The motivation of A. Mohamed's thesis (Supélec co-supervision) is to equip ambient systems with self fault-detection and diagnosis capabilities allowing them to check autonomously whether the intended actions were performed correctly by the actuators. To address this issue, an approach in which the fault detection and diagnosis is dynamically done at run-time, while decoupling actuators and sensors at design time, was proposed. We have introduced a Fault Detection and Diagnosis framework modeling the generic characteristics of actuators and sensors, and the effects that are expected on the physical environment when a given action is performed by the system's actuators. These effects are then used at run-time to link actuators (that produce them) with the corresponding sensors (that detect them). Most importantly the mathematical model describing each effect allows the calculation of the expected readings of sensors. Comparing the predicted values with the actual values provided by sensors allow us to achieve fault-detection in dynamic and heterogeneous ambient systems.

Concerning user's tasks, existing task models are static and used only at design time. In A. Gharsellaoui's thesis, we propose to use the task model at runtime, in order to track user actions, verify that he/she has not made any errors while accomplishing his/her tasks and to provide help when asked for. In particular, we propose an extension of the classical task models for ambient environments to allow their dynamic update at runtime. This extension consists in giving tasks, runtime states suitable with information received from the environment (task started, task suspended, task resumed, task done…). A second contribution consists in a monitoring and assistance system based on our dynamic task model. Furthermore, a simulator has been implemented and allowed us to validate our tasks tracking algorithm. A real user study in our intelligent room (IRoom) that exploits our tracking and assistance system is under development.

The Intelligent Room Platform

Topic 3: Haptic Interaction and Communication

***M. Ammi**, Y. Bellik, Y. Gaffary.Y. Tsalamlal, P. Issartel, M. Aziziaghdam, L. Besancon*

HAPCO (HAPtic interaction and COmmunication) investigates the role of haptic and tangible interaction for the perception of data and interpersonal communication. We can summarize our research in three main axes.

Visualization of abstract environments

This research was carried out in collaboration with the mechanics department of the LIMSI lab. It concerns the perception, characterization and visualization of CFD data. Several haptic rendering algorithms were developed according to various constraints of CFD data (discontinuities, variation of gradient, etc.). We proposed also a complete interactive approach for the analysis and characterization of Eulerian structures in complex flows including several vortices (Digiteo Fluctus). Recently, we investigated the use of tangible interaction for the visualization of CFD Data through several tolls exploiting a full 6DoF interaction (clipping plans, particles systems, etc.). We study also a hybrid interaction approach combining the tangible mode with the tactile mode for an optimal management of 6DoF/2DoF tasks (LIMSI-INRIA thesis). These different researches were carried out in the context of regional and internal projects (Digiteo, INRIA, ASP-CNRS, AI-CNRS)

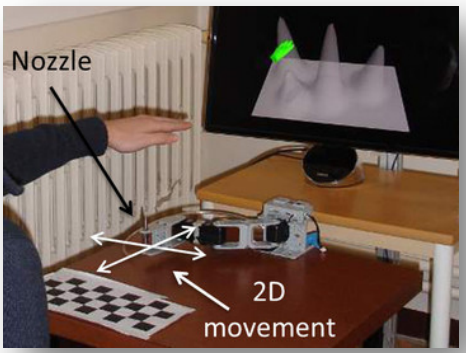
Collaborative haptics

This axis investigated the role of haptics for the communication and coordination of actions of several partners during collaborative manipulation of complexes structures (molecules). This research began with several studies to understand the contributions and the limits of collaborative strategies for the manipulation of closely coupled structures. These experiments highlight different communication constraints which limit the working efficiency. Based on these results, we studied and designed different collaborative metaphors for collaborative tasks like the collaborative selection, designation of targets, synchronous manipulation of structures, and collaborative search of targets. These tools were investigated in different contexts such as CAD and games. Beyond basic communication, we investigated the role of these tools to support the interpersonal awareness and the cognitive representation of partners' actions (FRESCO project, ANR). These different researches were carried out in the context of national and local projects (ANR, ASP-CNRS, AI-CNRS).

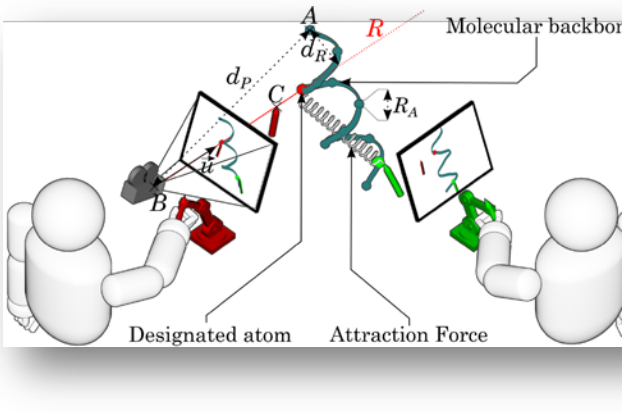
Affective communication

This axis deals with the human capacities for the communication of emotions through the haptic channel. We investigated both the kinesthetic and tactile channels. For the kinesthetic communication, we proposed an advanced analysis approaches (based on ANOVA, ACP and EM) for the characterization of haptic expressions of emotions according to several physical factors (velocity, fluidity, etc.). These haptic features were used to improve the recognition and discrimination of emotions expressed with virtual avatars. For the tactile communication, we proposed a new tactile stimulation strategy based on a thermoregulated air jet for a non-intrusive stimulation (Digiteo HumanTouch). Based on this stimulation strategy, we study how people perceive emotions with the tactile channel and how they combine these cues with the auditory information. This research was carried out with the CIAMS. Recently, we collaborated with ENSTA and CEA-LIST for the study of affective interaction with humanoid robots (IDEX HEROES). This project aims at developing a humanoid robot sensitive to the affective tactile stimulation and able to generate haptic reaction according to the emotional state of the user. Beyond the communication of emotions, we collaborate with artists for the design of a haptic interpresence platform for the real time interposal communication of emotions between two remote users (OSEO Canal Haptic project).

Tangible Visualization of CFD data



Air jet tactile stimulation



Collaborative manipulation of complex structures

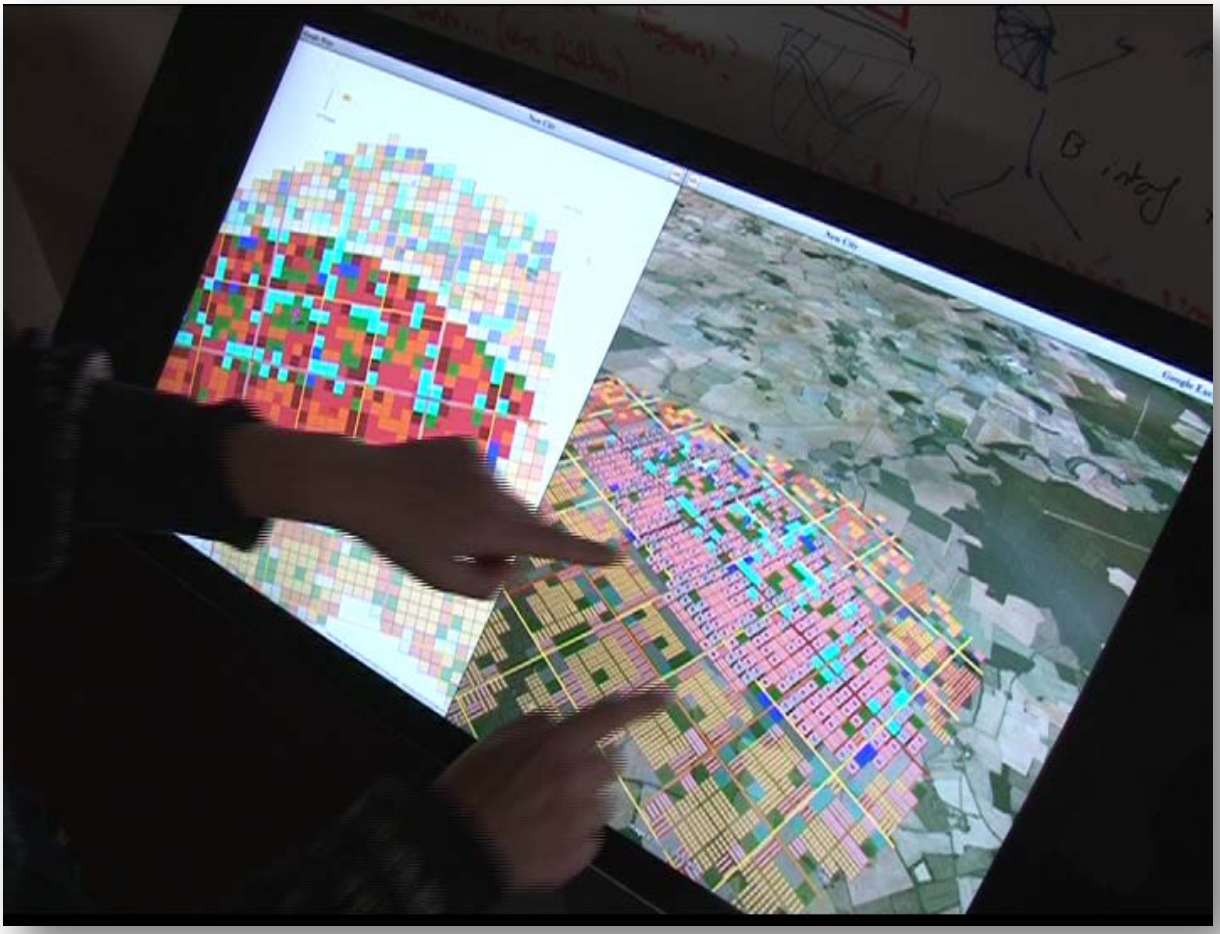
Haptic affective interaction with virtual avatars

Topic 4: Interaction on Tactile Surfaces

***F. Vernier**, C. Perin, E. Pointal*

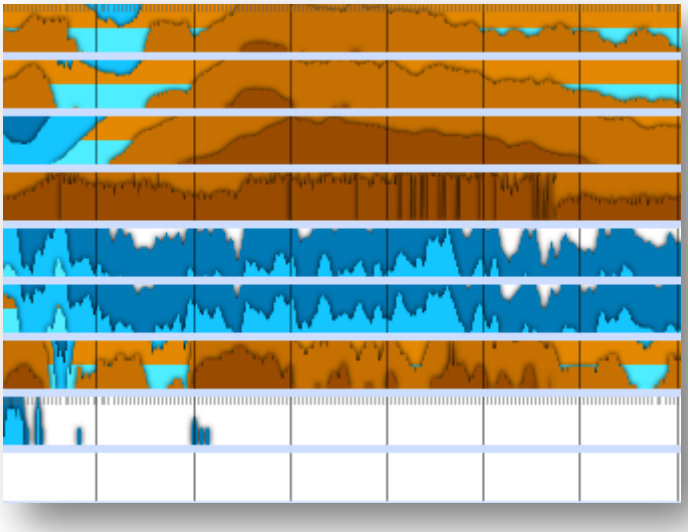
Human-Computer Interaction is a very broad research field with many sub domains like "Computer Supported Collaborative Work", "Multimodal Interfaces" or "3D user Interfaces". Every domain share the scientific methodology of studying a couple "human(s) + computer". However every subdomain follow its own goals according to the interaction context it focus on. Tactile Surfaces do not need to justify the technology feasibility (because millions of smartphone and tablet user prove it) or performances (it is well known tactile surfaces are less efficient than mouse). The main quest for tactile surfaces researchers is to find application domains where a large tactile surface makes more sense than the traditional mouse+keyboard+screen triple.

At LIMSI we already studied small scale 3D scene navigation in the previous time range (2009-2013) with the thesis of Rami Ajaj and we followed this way during the last 2 years with the Sustains project in a much larger scale. Instead of studying building/room scale size we enlarged studied scenes to the scale of a city. Sustains project aims at providing tools to help urban planner and politic decision makers while envisioning new cities or new urban neighborhoods. Unlike previous work we propose a dual coordinated view with 2D and 3D on the same tactile surface where users can smoothly interact between the 2D view (for panning and easy selection with no occlusion) and 3D view (rotating and zooming to achieve the desired point of view). Such partition of input becomes possible when surface is large enough and with enough resolution. It allows to keep a consistent interaction language inside the 2 views and among them while reducing the need for disambiguate gestures when they are nor performed on the same view.

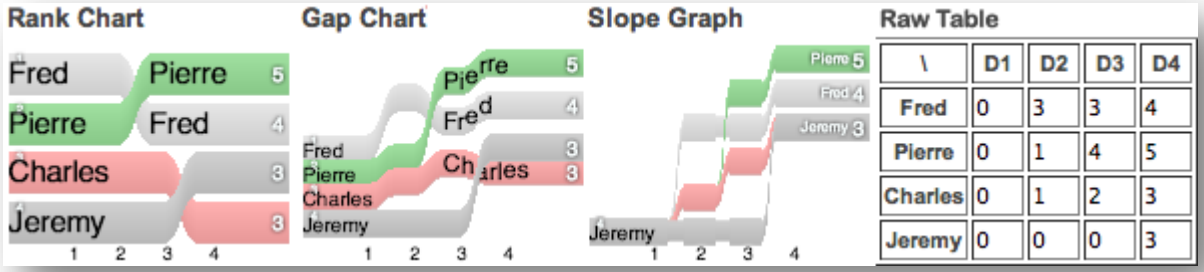


FUI Sustains project

During the same period of 2013-2014 we studied new potential big data domains where a large tactile surface could be meaningful. To move beyond spatial data we studied so far, we initiated research on multi-dimensional temporal data visualization. In the area two approaches exist: "shared space" and "aligned spaces". Share space graphs mix all the temporal graph together allowing to compare dimensions or elements, especially where graphs cross each other. Aligned spaces allow a better view of tendencies since each graph is displayed on a separate yet aligned space. We contributed in both field with 2 new contributions. Interactive Horizon Graphs use very few space per element (down to 10 pixels height per dimension/element) allowing hundreds of graphs on the same surface. We then propose Pan and Zoom interactions to allow fine grain tasks and usual "pinch" and "flick" gestures can be used to perform them. GapCharts is an evolution of slopegraphs using a ranking function to avoid occlusion, making element easy to distinguish: visually and for less precise inputs like tactile inputs.



Interactive Horizon Graphs using aligned spaces



GapChart a shared space visualization

Highlights

- [Charles Perin, Jeremy Boy and Frédéric Vernier] received the honorable mention award at the best visualization contest organized by the Visualization Pioneer Group within the IEEE VGTC committee. The scientific award was discerned during the VIS'2014 conference.
- Charles Perin, Frédéric Vernier, Jean-Daniel Fekete, Interactive Horizon Graphs: Improving the Compact Visualization of Multiple Time Series. Proceedings of the Annual Conference on Human Factors in Computing Systems (CHI'13), Paris, France, Apr. 2013, ACM.
- [Y. Bellik], editor of the special issue “Informatique Ambiante” of TSI (Technique et Science Informatiques), 2013.

Staff

Permanent staff

Last name	First name	Position	Employer	HDR	Group	Arrived	Left
Ammi	Mehdi	MC	Université Paris-Sud	HDR	AMI		
Bellik	Yacine	MCHC	Université Paris-Sud	HDR	AMI		
Béroule	Dominique	CR1	CNRS		AMI		
Bimbard	Franck	MC	Université Paris-Sud		AMI	01/04/2013	
Frenoux	Emmanuelle	MC	Université Paris-Sud		AMI		
Gouiffès	Michèle	MC	Université Paris-Sud		AMI	01/03/2013	
Jacquemin	Christian	PrCE	Université Paris-Sud	HDR	AMI		
Pointal	Laurent	IE1C	CNRS		AA/AMI		
Sansonnet	Jean-Paul	DR1	CNRS	HDR	AMI		31/12/2013
Turner	William	IRHC	CNRS		AMI		12/08/2013
Vernier	Frédéric	MC	Université Paris-Sud		AMI		

PhD Students

Last name	First name	Arrived	Thesis defense	Group	Ecole doctorale	School / University
Gueniat	Florimond	01/10/2010	06/12/2013	AERO/AMI	MIPEGE	Université Paris-Sud
Aziziaghdam	Mohammad	01/10/2014		AMI	EDIPS	Université Paris-Sud
Besançon	Lonni	01/11/2014		AMI	EDIPS	Université Paris-Sud
Bokaris	Panagiotis-Alexandros	01/10/2013		AMI	MIPEGE	Université Paris-Sud
Ding	Hui	01/11/2009	30/09/2013	AMI	EDIPS	Université Paris-Sud
Gaffary	Yoren	01/10/2011		AMI	EDIPS	Université Paris-Sud
Gharsellaoui	Asma	01/10/2011		AMI	EDIPS	Université Paris-Sud
Girard	Adrien	01/10/2010	12/05/2014	AMI	EDIPS	Université Paris-Sud
Issartel	Paul	01/10/2013		AMI	EDIPS	Université Paris-Sud
Mohamed	Ahmed	01/11/2009	19/11/2013	AMI	STITS	Université Paris-Sud
Perin	Charles	01/10/2011	17/11/2014	AMI	EDIPS	Université Paris-Sud
Pruvost	Gaëtan	01/09/2008	11/02/2013	AMI	EDIPS	Université Paris-Sud
Setkov	Aleksandr	01/10/2012		AMI	EDIPS	Université Paris-Sud
Tsalamlal	Mohamed Yacine	01/10/2012		AMI/CPU	EDIPS	Université Paris-Sud

Non permanent staff

Last name	First name	Position	Employer	Group	Arrived	Left
Gueniat	Florimond	CDD IE	Université Paris-Sud	AERO/AMI	01/10/2013	31/10/2013
Gueniat	Florimond	CDD IE	CNRS	AERO/AMI	01/11/2013	30/11/2013
Ding	Hui	ATER	Université Paris-Sud	AMI	01/10/2013	31/08/2014
Girard	Adrien	ATER	Université Paris-Sud	AMI	01/10/2013	31/08/2014
Martinez	Fabio	CDD Post-Doc	CNRS	AMI	01/12/2014	31/05/2016
Munsch	Vincent	IE	CNRS	AMI	01/11/2013	31/12/2013
Pointal	Elisabeth	IE	CNRS	AMI	01/09/2013	30/11/2013

Last name	First name	Position	Employer	Group	Arrived	Left
Pointal	Elisabeth	IE	CNRS	AMI	01/11/2013	31/12/2013
Gueniat	Florimond	CDD IE	Université Paris-Sud	AERO/AMI	01/10/2013	31/10/2013
Gueniat	Florimond	CDD IE	CNRS	AERO/AMI	01/11/2013	30/11/2013
Ding	Hui	ATER	Université Paris-Sud	AMI	01/10/2013	31/08/2014
Girard	Adrien	ATER	Université Paris-Sud	AMI	01/10/2013	31/08/2014
Martinez	Fabio	CDD Post-Doc	CNRS	AMI	01/12/2014	31/05/2016

Internships

Last name	First name	Arrived	Left	Prepared degree	School / University
Amghar	Nassim	11/01/2013	15/05/2013	M1 Informatique	Université Paris-Sud
Arbani	Amr	16/06/2014	29/08/2014	M	Supélec
Belkaid	Marwen	01/04/2013	30/09/2013	M	ENSEA
Christophe	Julien	03/03/2014	02/09/2014	M 2 informatique	Université Paris-Sud
Christophe	Julien	11/01/2013	15/05/2013	M1	Université Paris-Sud
Fruchard	Bruno	01/05/2013	31/07/2013	Licence	Université Paris-Sud
Gao	Jie	12/05/2014	01/08/2014	M1	Polytech Paris-Sud
Garaczi	Tamàs	02/09/2013	12/12/2013	M	Polytech Paris-Sud
Giraud	Maxime	05/02/2013	05/03/2013	Bap Pro SEN	ERP Maginot
Guerci	Erika	15/04/2014	15/09/2014	M	Universita degli Studi di Pavia
Issartel	Paul	05/03/2013	06/09/2013	M2	Université Paris-Sud
Le Meur Cuzon	Clara	01/06/2014	30/06/2014	Concours ENS Cachan	CPGE
Lema Midy	Marc	31/03/2014	31/08/2014	M	Université Paris-Ouest Nanterre
Lhies	Jason	23/06/2014	05/09/2014	Ingénieur	Supélec
Massardier	Anaïs	14/04/2014	04/07/2014	DUT informatique	Université Paris-Sud
Munsch	Vincent	25/03/2013	25/08/2013	M2	Université Paris-Sud
Naliato	Florent	16/06/2014	11/07/2014		CNED
Nedjar	Nassima	20/06/2014	04/07/2014	L3	Université Paris-Sud
Prokopiou	Ioannis	02/04/2013	31/08/2013	M2 Informatique Interaction	Université de Crête
Rabinow	Julien	01/05/2013	31/07/2013	L3	Université Paris-Sud
Stratigi	Kalliopi	02/04/2013	31/08/2013	M2 Informatique Interaction	Université de Crête

Indicators of scientific notoriety

Prizes and awards

- [Charles Perin, Jeremy Boy and Frédéric Vernier] received the honorable mention award at the best visualization contest organized by the Visualization Pioneer Group within the IEEE VGTC committee with their submission entitled "Le Tour de France 2014 at a Glance". The scientific award was discerned during the VIS'2014 conference.

Scientific events

- [M. Ammi], chair of the Workshop on Affective Haptics for Human-Robot Interaction, IEEE ICRA 2014.
- [M. Ammi], member of the organization committee of EuroHaptics 2014
- [M. Ammi], member the program committee of IEEE IROS 2014
- [M. Ammi], member is technical program committee IEEE ROMAN 2014
- [Y. Bellik], member of the program committee for the 4th Workshop on Speech and Language Processing for Assistive Technologies (SLPAT 2013), August 21-22, Grenoble, France.
- [J-P. Sansonnet], member of steering committee of national conference JFSMA, 2008-2013

Editorial activities

- [M. Ammi], technical editor of EuroHaptics 2014
- [Y. Bellik], editor of the special issue “Informatique Ambiante” of TSI (Technique et Science Informatiques), 2013.
- [Y. Bellik], member of the editorial board of JIPS (Journal d’Interaction Personne-Système)
- [C. Jacquemin], Member of the scientific committee of EAI Transactions on Creative Technologies
- [J-P. Sansonnet], member of scientific board of international journal Scientia, 2008-2013

Invited lectures, talks or seminars

- [M. Ammi], "Haptics: from Interaction to Communication", CEA-LIST, Saclay, January, 2014.
- [M. Ammi], “Human factors for the energy management” Conférence Crédit Foncier, November, 2014.
- [M. Gouiffès], M. 2014. Image processing at LIMSI: matching robust descriptors for video-surveillance and spatial augmented reality, Invited talk at Technicolor 16 July 2014.
- [F. Vernier], invited talk closing keynote at SIGRAG 2014

Participation in expertise and administration of research

- [M. Ammi] participated to 3 committees for MCF recruitment : MCF 61, University of Pierre et Marie Curie (2014) : poste 4208, MCF 61, University of Pierre et Marie Curie (2014) : poste 4264, MCF 61, University of Pierre et Marie Curie (2013) : poste 4140. Leader of the EuroVR Special Interest Group on Haptics (EuroVR Haptic SIG). Vice chair for Industrial Relationship at the IEEE Technical Committee on Haptics (IEEE TCH). Member of the European Association for Virtual Reality and Augmented Reality (EuroVR). Member of the EuroHaptics Society (EuroHaptics). Member of the French Virtual Reality Association: AFRV. Reviewer for Singapore Academic Research Council, 2013.
- [Y. Bellik] : reviewer for the ANR call 2014 member of the Special Interest Group on Non-Visual Interaction (ACM SIGCHI). member of the Pervasive Adaptation Research Network (PerAda). Member of the FOCAS (Fundamental of Collective Adaptive Systems) coordination action. Member of the MdT (Modèles de Tâches) working group of AFIHM (Association Francophone d'Interaction Homme-Machine). Member of conseil du département CHM at LIMSI
- [E. Frenoux] participated for MCF recruitment : 2013 in Polytech Paris-Sud (27MCF4160)
- [M. Gouiffès] participated to 4 committees for MCF recruitment : 2013 in Lille (61MCF0971) ; INSA Rennes (61MCF4025) ; UFR de Sciences Paris-Sud (61MCF4144 et 1750); 2014 in UFR Sciences Paris-Sud (61MCF0609). Reviewer of 6 projects for Curiositas festival (2013 and 2014), reviewer of 3 projects Sciences et Société Diagonale 2014.
- [C. Jacquemin], member of the network “Art Numérique”, Enghien les Bains, 2007-2013

Ph.D and Habilitation committees

- [M. Ammi], 1*reviewer, 1*examiner
- [Y. Bellik], 3*reviewer, 1*examiner, 3*co-supervisor
- [E. Frenoux], 1*co-supervisor
- [M. Gouiffès], 2*examiner
- [C. Jacquemin], 2*president, 1*co-supervisor
- [F. Vernier], 1*co-supervisor. Position in Scientific Concils or Associations or Networks
- [Y. Bellik], member of the RTRA Digiteo program committee
- [E. Frenoux], member B of the CCSU 27 of University Paris-Sud
- [M. Gouiffès], Vice-President B of the CCSU 60-61-62 of University Paris-Sud
- [C. Jacquemin], member of CCSU18 of University Marne-La-Vallée 2013
- [J-P. Sansonnet], member of the scientific committee of Supélec (section computer science), 2010- 2013

Dissemination and scientific outreach

- [G. Pruvost & Y. Bellik], Youpi: Open source UPNP software library, (http ://sourceforge.net/projects/youpi/files/)

Research conventions and contracts

Starting date	Ending date	Acronym	Category	Funding agency/Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/01/14	30/06/17	ChaNTeR	Collaboration de recherche	ANR	d'Alessandro Christophe	d'Alessandro Christophe	National	248 082	CONTINT
01/01/14	30/06/17	ECHO	Collaboration de recherche	ANR	MERVANT-ROUX Marie-Madelaine	Katz Brian	National	167 564	CULT
01/10/11	30/09/14	FRESCO	Collaboration de recherche	ANR	Auvray Malika	Auvray Malika	National	169 941	JCJC
01/10/12	31/03/16	MoCA	Collaboration de recherche	ANR	Duhaut Dominique	Martin Jean-Claude	National	160 887	CONTINT
01/08/12	30/07/16	BiLi	Collaboration de recherche	OSEO	Parmentier Matthieu	Katz Brian	National	392 000	Pôle de compétitivité
10/12/10	28/02/15	SUSTAINS	Collaboration de recherche	OSEO	Mahe Erwan	Vernier Frédéric	National	122 300	Pôle de compétitivité
01/11/14	30/06/16	MAPOCA	Collaboration de recherche	Digiteo	Gouiffès Michèle	Gouiffès Michèle	National	76 950	
01/10/12	30/09/15	Human Touch		Digiteo	Ammi Mehdi	Ammi Mehdi	National	102 200	encadrement de thèse
01/10/14	30/09/17	IDI	Autre	FCS Campus Paris Saclay	Ammi Mehdi	Ammi Mehdi	National	115 000	Financement de thèse
01/10/14	30/09/18		Collaboration de recherche	RPE	Ammi Mehdi	Ammi Mehdi	Industriel	267 448	
01/06/14	31/10/14		Contrat de prestations de service	RTE	Ammi Mehdi	Ammi Mehdi	Industriel	9 000	
15/03/06	15/03/16	SEVEN-confidentialité	Accord de secret	EDF	Jacquemin Christian	Jacquemin Christian	Industriel	-	
21/11/13	20/11/15		Accord de secret	HGH Systèmes Infrarouges	Gouiffès Michèle	Gouiffès Michèle	Industriel	-	
07/02/14	06/08/15		Accord de secret	Pages Jaunes	Vernier Frédéric	Vernier Frédéric	Industriel		

Starting date	Ending date	Acronym	Category	Funding agency/Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
25/07/14	24/07/20		Accord de secret	Rénovation Plaisir Energie	Ammi Mehdi	Ammi Mehdi	Industriel	-	
01/10/13	30/09/16	Gardien du temple	Collaboration de recherche	Diagonale Paris Saclay	Jacquemin Christian	Jacquemin Christian	National	-	co encadrement de thèse

Valorization

Patents, software, licence agreements…

Patent	LIMSI Author	Co-owner	Date	Comment
TVIZ tablet based 3D visualisation	Ammi Mehdi	Université Pierre et Marie Curie	01/04/2013	
P-TRONICS	Ammi Mehdi	Université Paris-Sud	25/08/2014	patentibility under review

Scientific publications 2013-2014

Doctoral theses and HdR

1. Gueniat, F., *Détection de Structures Cohérentes dans des Écoulements Fluides et Interfaces Homme-Machine pour l'Exploration et la Visualisation Interactive de Données Scientifiques* 2013, thèse de l'Université Paris-Sud. Soutenue à Orsay, le 06/12/2013, 199 p.
2. Mohamed, A., *Fault detection in Ambient Intelligence based on the modeling of physical effects* 2013, thèse de Supélec-LIMSI. Soutenue à Gif-sur-Yvette, France, le 19 novembre 2013, 235p p.
3. Perin, C., *Direct Manipulation for Information Visualization* 2014, thèse de l'Université Paris-Sud. Soutenue à Orsay, le 17/11/14, 215 p.
4. Pruvost, G., *Modélisation et conception d'une plateforme pour l'interaction multimodale distribuée en intelligence ambiante* 2013, thèse de l'Université Paris-Sud. Soutenue à Orsay, France, le 11 février 2013, 269 p.

Articles in peer reviewed scientific journals

1. Ammi, M. and B. Katz, *Intermodal audio-haptic metaphor: Improvement of target search in abstract environments.* International Journal of Human-Computer Interaction, 2014. **30** (11): pp.921-933.
2. Avril, M., M. Chetouani, and N. Sabouret, *Étude d'une collaboration socio--affective entre une personne et le robot Jazz.* Interfaces numériques, 2013. **2** (1): pp.57-76.
3. Bouchara, T., C. Jacquemin, and B. Katz, *Cueing multimedia search with audio-visual blur.* ACM Transactions on Applied Perception, 2013. **10** (2): pp.7_1-7_21.
4. Bouchet, F. and J.-P. Sansonnet, *Influence of FFM/NEO PI-R personality traits on the rational process of autonomous agents.* International Journal of Web Intelligence and Agent Systems, 2013. **11**: pp.203-220.
5. Bouchet, F. and J.-P. Sansonnet, *Agents conversationnels psychologiques : Modélisation des réactions rationnelles et comportementales des agents assistants conversationnels.* Revue d'Intelligence Artificielle (RIA), 2013. **27** (6): pp.679-708.
6. Buisine, S., M. Courgeon, A. Charles, C. Clavel, J.-C. Martin, N. Tan, and O. Grynszpan, *The role of body posture in the recognition of emotion in contextually-rich scenarios.* International Journal of Human-Computer Interaction, 2013. **30** (1): pp.52-62.
7. Campano, S., É. de Sevin, V. Corruble, and N. Sabouret, *Une approche pour la simulation de comportements émotionnels fondée sur la théorie de la conservation des ressources.* Technique et Science Informatiques, 2013. **32** (1): pp.111-136.
8. Delprat, N. and C. Jacquemin, *VIDA - Une thématique art-science dans un laboratoire de recherche scientifique*. Technique et Science Informatiques, 2013. **32** (3-4): pp.499-502.
9. Fdili Alaoui, S., F. Bevilacqua, B. Bermudez Pascual, and C. Jacquemin, Dance interaction with physical model visuals based on movement qualities. International Journal of Arts and Technology, IJART, 2013. 6 (4): pp.357-387.

10. Fdili Alaoui, S., C. henry, and C. Jacquemin, *Physical modelling for interactive installations and the performing arts.* International Journal of Performance Arts, and Digital Media, 2014. **10** (2): pp.159-178.
11. Gaffary, Y., M.V. Eyharabide, J.-C. Martin, and M. Ammi, *Clustering approach to characterize haptic expressions of emotions.* ACM Transactions on Applied Perception, 2013. **10** (4): pp.18p.
12. Gouiffès, M., B. Planes, and C. Jacquemin, *HTRI: High Time Range Imaging.* Journal of Visual Communication and Image Representation, 2013. **24** (3): pp.361-372.
13. Jacquet, C., A. Mohamed, M. Mateos, B. Jean-Bart, P. Bretault, I. Schnepp, and Y. Bellik, *An ambient assisted living framework with automatic self-diagnosis.* International Journal On Advances in Life Sciences, 2013. **5** (1-2): pp.10p.
14. Laguzet, F., A. Romero Mier y Téran, M. Gouiffès, L. Lacassagne, and D. Etiemble, Color tracking with contextual switching. Real-Time implementation on CPU. Journal on Real Time Image Processing, 2013. pp.1-18.
15. Martin, J.-C., M. Courgeon, G. Rautureau, and O. Grynszpan, *Joint Attention Simulation using Eye-Tracking and Virtual Humans.* IEEE Transactions on Affective Computing (TAC), 2014. (3): pp.238-250.
16. Martin, J.-C., Y. Gaffary, V. Eyharabide, and M. Ammi, *The impact of combining kinesthetic and facial expression displays on emotion recognition by users.* International Journal of Human Computer Interaction (IJHCI), 2014. **30** (11): pp.904-920.
17. Rebai, I., E. Machrouh, Y. Bellik, G. Pruvost, and J.-P. Sansonnet, *Influence des modalités de sortie d'un système sur les modalités de l'utilisateur. Cas des environnements ambiants de type pièces intelligentes.* Technique et Science Informatiques, 2013. **32** (5): pp.575-604.
18. Romero, A., L. Lacassagne, M. Gouiffès, and A. Hassan Zahraee, *Covariance tracking: architecture optimizations for embedded systems.* Eurasip Journal on Advances in Signal Processing, 2014. pp.15p
19. Sansonnet, J.-P., *Personnification de Topiques : Un cadre de modélisation pour la prise en compte des réactions relationnelles dans les topiques conversationnels.* Revue d'Intelligence Artificielle (RIA), 2014. **28** (1): pp.9-41.
20. Vernier, F., A. Afonso, S. Buisine, J. Barré, and A. Aoussat, *Trains of thought on the tabletop: visualizing association of ideas improves creativity.* Personal and Ubiquitous Computing, 2013. **17** (7): pp.1-9.

Conferences with proceedings and review committee

1. Amouroux, É., T. Huraux, F. Sempé, N. Sabouret, and Y. Haradji. Simulating household activities to lower consumption peaks (Demonstration). in International Conference on Autonomous Agents and Multiagent Systems. 2013. Saint Paul, USA. 1-2.
2. *Amouroux, É., T. Huraux, F. Sempé, N. Sabouret, and Y. Haradji. SMACH : Simuler l'activité humaine pour limiter les pics de consommation électrique*. in *Journées Francophones sur les Systèmes Multi-Agents*. 2013. Lille, France. 1-10.
3. Campano, S., É. de Sevin, V. Corruble, and N. Sabouret. *An evaluation of the COR-E computational model for affective behaviors*. in *International Conference on Autonomous Agents and Multiagent Systems*. 2013. Saint Paul, USA. 1-8.
4. Darty, K., J. Saunier, and N. Sabouret. *Extraction de comportements pour l'étude de la crédibilité des agents*. in *Journées Francophones sur les Systèmes Multi-Agents*. 2013. Lille, France. 1-10.
5. Dubois, M., P. Tarroux, and E. Frenoux. Using n-grams models for visual semantic place recognition. in International Joint Conference on Computer Vision Theory and Applications. 2013. Barcelona, Spain. 239_1-239_8.
6. Dubus, G., F. Popineau, Y. Bourda, and J.-P. Sansonnet. *Parametric reasoning agents extend the control over standard behaviors*. in *IEEE/WIC/ACM International Conference on Intelligent Agent Technology*. 2013. Atlanta, USA: IEEE Computer Society. 163-170.
7. Fdili Alaoui, S., C. Jacquemin, and F. Bevilacqua. *Chiseling Bodies: an Augmented Dance Performance*. in *ACM SIGCHI Conference on Human Factors in Computing Systems*. 2013. Paris, France: ACM. 2915-2918.
8. Gaffary, Y., M.V. Eyharabide, M.Y. Tsalamlal, J.-C. Martin, and M. Ammi. *Comparison of Statistical Methods for the Analysis of Affective Haptic Expressions*. in *International Workshop on Haptic and Audio Interaction Design*. 2013. Daejeon, Korea. 10p.
9. Gharsellaoui, A., Y. Bellik, and C. Jacquet. *A run time executable task model for ambient intelligent environments*. in *The 2013 International Workshop on Intelligent Techniques for Ubiquitous Systems (ITUS 2013)*. 2013: IEEE. 1-6.
10. Gharsellaoui, A., Y. Bellik, and C. Jacquet. *Un système d'aide et de suivi des tâches utilisateur dans un environnement ambiant*. in *Conférence Francophone sur l'Interaction Homme Machine*. 2014. Lille, France: ACM. 130-138.
11. Girard, A., M. Auvray, and M. Ammi. *Collaborative Metaphor for Haptic Designation in Complex 3D Environments*. in *ACM Symposium on Applied Perception*. 2014. Vancouver, British Columbia, Canada. 31-37.

12. Girard, A., Y. Bellik, and M. Ammi. *Comparative study of collaborative methods to control rotation of shared objects*. in *IEEE Haptics Symposium*. 2014. Houston, USA. 531-537.
13. Girard, A., Y. Bellik, M. Auvray, and M. Ammi. *Visuo-Haptic tool for collaborative adjustment of selections*. in *International Workshop on Haptic and Audio Interaction Design*. 2013. Daejeon, Korea. 1-10.
14. Girard, A., Y. Bellik, M. Auvray, and M. Ammi. *Collaborative approach for dynamic adjustment of selection areas in polygonal modelling*. in *IEEE Symposium on 3D User Interfaces*. 2013. Orlando, Florida. 1-2.
15. Giraud, T., M. Soury, J. Hua, A. Delaborde, M. Tahon, D.A. Gomez Jauregui, M.V. Eyharabide, E. Filaire, C. Le Scanff, L. Devillers, B. Isableu, and J.-C. Martin. Multimodal expressions of stress during a public speaking task. in International Conference on Affective Computing and Intelligent Interaction. 2013. Genève, Suisse. 417-422.
16. Hoet, S. and N. Sabouret. *Un modèle de mémoire pour l'apprentissage de communication dans un SMA*. in *Journées Francophones sur les Systèmes Multi-Agents*. 2013. Lille, France. 1-10.
17. Huraux, T., É. Amouroux, and N. Sabouret. *Simulating human activities to investigate household energy consumption*. in *International Conference on Agents and ARTificial intelligence*. 2013. Barcelona, Spain: Springer-Verlag. 10p.
18. Issartel, P., F. Gueniat, and M. Ammi. *Slicing techniques for handheld augmented reality*. in *IEEE Symposium on 3D User Interfaces*. 2014. Minneapolis, USA: IEEE. 39-42.
19. Jacquemin, C., P.-A. Bokaris, M. Gouiffès, and J.-m. Chomaz. *Photometric compensation to dynamic surfaces in a projector-camera system*. in *Color and Photometry in Computer Vision Workshop at European Conference on Computer Vision (ECCV)*. 2014. Zurich, Switzerland: Springer. 12.
20. Jacquet, C., A. Mohamed, F.é.é. Boulanger, C.é. Hardebolle, and Y. Bellik. *Building heterogeneous models at runtime to detect faults in ambient-intelligent environments*. in *International Workshop on Models at run.time*. 2013. Miami, USA. 1-11.
21. Jones, H. and N. Sabouret. *TARDIS - A simulation platform with an affective virtual recruiter for job interviews*. in *1st International Workshop on Intelligent Digital Games for Empowerment and Inclusion (IDGEI 2013)*. 2013: Technical University of Crete. 8p.
22. Perin, C., M. Christie, F. Vernier, and C. Lino. *CollaStar : Interaction collaborative avec des données multidimensionnelles et temporelles*. in *Conférence Francophone sur l'Interaction Homme Machine*. 2013. Bordeaux, France. 10p.
23. Perin, C. and P. Dragicevic. *Manipulation de Sliders Multiples par Franchissement*. in *Conférence Francophone sur l'Interaction Homme Machine*. 2014. Lille, France: ACM. 48-54.
24. Perin, C., F. Vernier, and J.-D. Fekete. Interactive horizon graphs: improving the compact visualization of multiple time series. in ACM SIGCHI Conference on Human Factors in Computing Systems. 2013. Paris, France. 3217-3226.
25. Perin, C., R. Vuillemot, and J.-D. Fekete. *SoccerStories: a kick-off for visual soccer analysis*. in *The Premier Forum for Advances in Visualization*. 2013. Atlanta, USA: IEEE. 2506-2515.
26. Perin, C., R. Vuillemot, and J.-D. Fekete. *A Table! Improving temporal navigation in soccer ranking tables*. in *ACM SIGCHI Conference on Human Factors in Computing Systems*. 2014. Toronto, Canada: ACM. 10p.
27. Romero, A., M. Gouiffès, and L. Lacassagne. *Total Bregman divergence for multiple object tracking*. in *International Conference on Image Processing*. 2013. Melbourne, Australia. 4p.
28. Romero Mier y Téran, A., M. Gouiffès, and L. Lacassagne. *Enhanced Local Binary covariance matrices (ELBCM) for texture analysis and object tracking*. in *International Conference on Computer Vision / Computer Graphics Collaboration Techniques and Applications*. 2013. Berlin, Germany: ACM. 10_1-10_8.
29. Romero Mier y Téran, A., L. Lacassagne, A. Hassan Zahraee, and M. Gouiffès. *Covariance tracking architecture optimizations for embedded systems*. in *Conference on Design & Architectures for Signal & Image Processing*. 2013. Cagliari, Italy. 5p.
30. Sabouret, N. and M. Belkaid. *A logical model of Theory of Mind for virtual agents in the context of job interview simulation*. in *International Workshop on Intelligent Digital Games for Empowerment and Inclusion*. 2014. Haifa, Israel. 8.
31. Sansonnet, J.-P. *Conversational topics handle social relationships*. in *International Conference on Affective Computing and Intelligent Interaction*. 2013. Geneva, Switzerland: IEEE Computer Society. 203-206.
32. Sansonnet, J.-P. and Y. Bellik. *Expressing the personality of an intelligent room through ambient output modalities*. in *International Conference on Ambient Computing, Applications, Services and Technologies*. 2013. Porto, Portugal: IARIA XPS Press. 6p.
33. Sansonnet, J.-P. and F. Bouchet. *Moteurs de personnalité pour agents dialogiques : étude d'un modèle pour les traits interpersonnels*. in *Journées Francophones sur les Systèmes Multi-Agents*. 2013. Lille, france: Cépadues Editions. 105-114.

34. Sansonnet, J.-P. and F. Bouchet. *Managing personality influences in dialogical agents*. in *International Conference on Agents and ARTificial intelligence*. 2013. Barcelona, Spain: Institute for Systems and Technologies of Information, Control and Communication (INSTICC). 89-98.
35. Savary, M., D. Schwarz, D. Pellerin, F. Massin, C. Jacquemin, and R. Cahen. *Dirty tangible interfaces: expressive control of computers with true grit*. in *ACM SIGCHI Conference on Human Factors in Computing Systems*. 2013. Paris, France: ACM. 2991-2994.
36. Setkov, A., M. Gouiffès, and C. Jacquemin. *Color invariant feature matching for image geometric correction*. in *International Conference on Computer Vision / Computer Graphics Collaboration Techniques and Applications*. 2013. Berlin, Germany: ACM. 7_1-7_8.
37. Tardis, C. and N. Sabouret. *The TARDIS framework: intelligent virtual agents for social coaching in job interviews*. in *International Conference on Advances in Computer Entertainment Technology*. 2013. Twente, The Netherlands: Springer-Verlag. 476-491.
38. Tsalamlal, M.Y., P. Issartel, N. Ouarti, and M. Ammi. *HAIR: HAptic feedback with a mobile AIR jet*. in *IEEE international conference on robotics and automation*. 2014. Hong Kong: IEEE. 2699 - 2706.
39. Tsalamlal, M.Y., N. Ouarti, and M. Ammi. *Psychophysical study of air jet based tactile stimulation*. in *Joint EuroHaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems (World Haptics Conference)*. 2013. Deajeon, South Korea: IEEE. 639-644.
40. Tsalamlal, M.Y., N. Ouarti, and M. Ammi. *Non-intrusive haptic interfaces: state-of-the art survey*. in *International Workshop on Haptic and Audio Interaction Design*. 2013. Deajeon, Korea: Springer Verlag. 9p.

CPU
Cognition Perception Use

JEAN-CLAUDE MARTIN

The goal of the CPU group (Cognition, Perception, Use) is to conduct pluridisciplinary research with the joint perspective from Psychology, Ergonomics and Computer Science in order to address research questions about (or that can be useful for) the design or evaluation of Human-Computer Interaction. Members of the group include two professors in Computer Science, four associate professors in Psychology (including one in Ergonomics), two CNRS Emeritus Directors of Research, and one research engineer. Day to day interactions between researchers from these disciplines are thus supported, for example for co-supervising PhD students and for working together on joint collaborative projects. Until 2013, five topics were active in the CPU group: “Virtual Agents and Emotions”, “Cognitive Ergonomics”, “Distant Collaboration for Creative Design”, “Perceptive Systems and Models” and “Image, Language, Space”. Since 2014, the research conducted in the group has been restructured to better represent the recent evolution of the research conducted by the different researchers, to consider the members who left the group and the new members who joined the group. Three pluridisciplinary complementary topics were identified. These three topics are: “Learning and cognitive process”, “Cognition, Affective Multimodal Interaction and Intelligent Agents”, and “Use, Activity, Behavior”.

Research activities

Topic 1 - Learning and cognitive processes

Vincent Boccara, Céline Clavel, Marie-Paule Daniel, Virginie Demulier, Michel Denis, Jean-Claude Martin, Nicolas Sabouret

Learning is a complex phenomenon involving cognition, emotions, and multimodal expressions and perception. Experimental and field studies are conducted in the group to consolidate the understanding of human learning and cognitive processes in teenagers or adults. They are based on multiple theoretical backgrounds drawing mutual enrichment from their complementarities (psychology, informatics, ergonomics and professional didactic). Moreover, several research aim at designing learning devices and systems (hardware, software, scenario, etc.) with the double aim of: 1) studying learning and cognitive processes in order to guide the design process, and 2) using these learning devices and systems to understand and evaluate human learning and cognitive processes.

For example a longitudinal study was conducted with teenagers from a secondary school interacting with a platform for learning to speak and understand English as a foreign language[1]. Speaking in a foreign language is known to be a source of anxiety. We automatically analyzed the postural behaviors of the teenagers using video processing techniques. We observed that teenagers tended to move forward when receiving positive feedbacks. Symmetrically, they tended to move backwards

[1] *This study was conducted within the project INTELLILANGUE (funding Investissement d’Avenirs ; partners : BORDAS, PowowBox, LIMSI).*

when receiving negative feedbacks, and that was even truer for anxious teenagers. These results were interpreted in the framework of the action tendency theory of emotions[2].

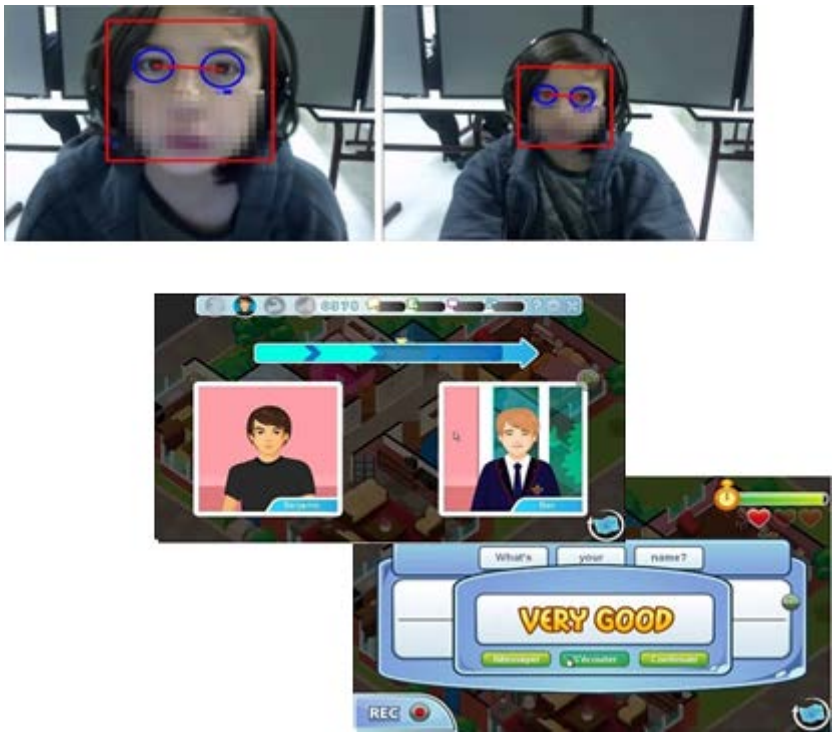


Figure. Video analysis of approach vs. avoidance behaviors of teenagers receiving positive vs. negative feedback from a software for learning English

The group also considers professional learning and training for adults. The approach consists in observing and analysing work activities in order to design a training module. For example, in the area of radioactivity management, the following questions were tackled about a technique for simulating radioactivity[3] : How might this technique impact the training of radioprotection techniciens? How to design training scenarios using this technique so that they are close to real work cases?[4]

Examples of work situations in nuclear power plant

Learning and training for adults is now a key issue in our everyday competitive world. The high rate of unemployment in multiple countries led to changes in the goals of these specific learning programs[5] and higher expectations from workers and companies. Yet, current eLearning systems do not offer fully personalized educational program[6]. It thus becomes necessary to consider interfaces

[2] *Gómez Jáuregui, D. A., Philip, L., Clavel, C., Padovani, S., Bailly, M., and Martin, J.-C. "Video Analysis of Approach-Avoidance Behaviors of Teenagers Speaking with Virtual Agents". In Proceedings of the 15th International Conference on Multimodal Interfaces (ICMI 2013). Sydney, Australia, December, 9-13th 2013*

[3] *This research was conducted within the CERNUM project (with EDF)*

[4] *Boccara et al.*

[5] *Carré, P. & Caspar, P. (1999). Traité des sciences et techniques de la formation. Paris: Dunod*

[6] *Vonthron, A.M., Lagabrielle, C. & Pouchard, D. (2007). Le maintien en formation professionnelle qualifiante : effets de déterminants motivationnels, cognitifs et sociaux. L'Orientation Scolaire et Professionnelle, 36, 3, 401-420*

such as virtual agents that can adapt to users and display expressive signs that facial expressions, postures and other intuitive modalities. If endowed with social capabilities, such virtual agents are expected to impact the feeling of social support but also the motivation of users to continue and finish the educational program. Indeed the motivation of adults with respect to any long-term or repeated educational program change over time and depends in emotional events (e.g. failure to pass one of the exams) and on one's own feeling of self efficiency[7].

Spatial cognition. A set of recent publications reported new findings collected in three experimental programs investigating the mental representation of space. The first study resulted from a collaboration with the University of Cyprus through a project supported by ERC and the Cyprus Research Promotion Foundation. Four experiments investigated whether spatial relations encoded from reading a narrative (about a protagonist and a set of objects surrounding him or her) are updated by people when the text describes changes in the protagonist's position. The responses of participants invited to make judgments about objects' relations indicated that they relied on the initial representation constructed during encoding rather than on the updated relations. Further data attested that the mental spatial representations constructed from narratives differ from those based on perceptually experienced environments. The second study, based on a collaboration with the AA group of LIMSI and supported by an ANR grant, investigated the processes involved when blind people attempt to build new spatial knowledge while exploring indoor spaces or, alternatively, listening to acoustic events delivered by an auditory virtual reality device. The results showed that the exploration of virtual acoustic room simulations provides valuable information for the construction of coherent cognitive maps. The third study was based on a collaboration with the University Paris Descartes supported by an ANR grant. It tested the hypothesis that the memorability of a route is dependent on the frequency with which people are exposed to visual landmarks. Participants were tested after navigating either along a route lacking visually salient features or a route rich in such features. Recall and recognition measures confirmed the functional role of landmarks in route memory and wayfinding .

Topic 2 - Cognition, Affective Multimodal Interaction and Intelligent Agents

Céline Clavel, Virginie Demulier, Jean-Sylvain Liénard, Jean-Claude Martin, Nicolas Sabouret

Designing intelligent human-computer interfaces (in applications such as learning and training described above) requires understanding and supporting users' cognitive and affective processes as well as the expression and perception of these processes in multiple modalities such as facial expressions and posture. Research in affective and social computing aims for example at designing systems that are able to recognise user's affect using multiple modalities (e.g. video, physiological measures, …), reason about the underlying emotional processes, and display multimodal expressions of emotions via a virtual character[8]. There is a growing multidisciplinary stream of research on Affective Computing. A dedicated journal has been created (IEEE Transaction on Affective Computing, Impact Factor: 3,84). An international conference is held bi-annualy (ACII). An international association has been funded (AAAC[9]).

Such multimodal affective interfaces can be particularly useful for training users in situations eliciting emotions. For example, job interviews are well known for eliciting social stress[10]. There is an experimental protocol which has been designed around this question: the Trier Social Stress Test. Although it is agreed that corpora are required for designing multimodal interfaces, there is currently no available corpus of multimodal data about user's behaviors and states during job interviews. We

[7] *Michel, S. (1989). Peut-on gérer les motivations ? Paris: Presses Universitaires de France.*
[8] *R.W. Picard (1997), "Affective Computing," MIT Press, Cambridge, 1997*
[9] *Association for the Advancement of Affective Computing (AAAC) http://emotion-research.net/*
[10] *Kirschbaum, C., Pirke, K. M., & Hellhammer, D. H. (1993). The 'Trier Social Stress Test'—a tool for investigating psychobiological stress responses in a laboratory setting. Neuropsychobiology, 28(1-2), 76-81.*

collected a corpus of 43 participants' behaviors in multiple modalities (video, audio, physio) and data about inter-individual differences[11] [12].

Such corpora are useful for designing virtual system for training students to pass job interviews.

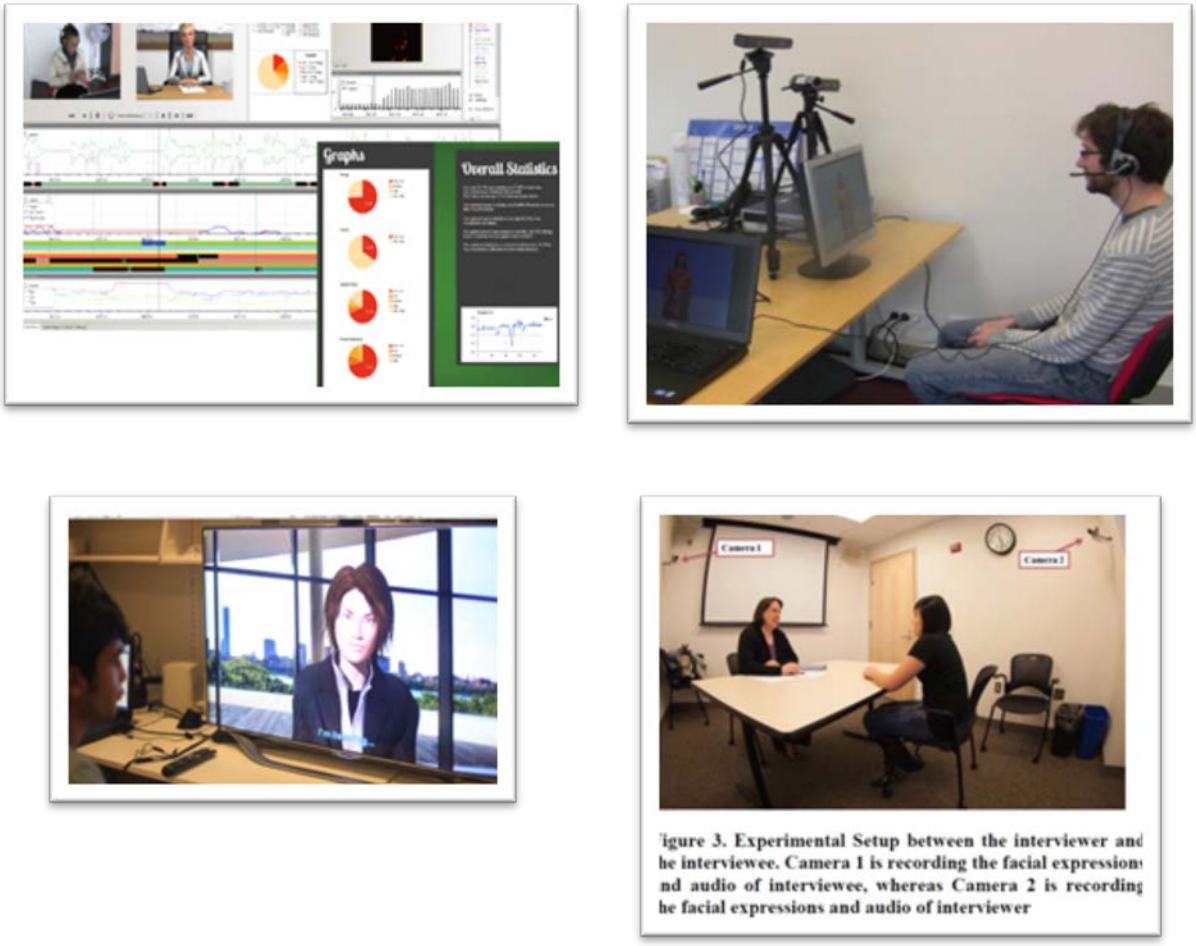


Figure : Two approaches for training students for job interviews:
the TARDIS European project (above) and the MACH project with MIT Media Lab (below).

Multimodal affective interfaces require models inspired from Psychology, especially if they are expected to enable long-term interactions between the user and so-called artificial companions (e.g. virtual assistant, social robot). These interfaces were observed to be promising in several application areas such as e-learning, edutainment, assistance, remediation but also experimental studies about human perception. Among the different available approaches to emotion, we focus on the appraisal approach since it is relevant for situated human-computer interaction. Our interest in affects goes beyond basic emotions and includes the superposition of several emotions, complex emotions, personality and interpersonal attitudes. This topic is quite relevant to the CPU group thanks to its strong links between Psychology and Human-Computer interfaces. We adopt an experimental approach and ground our work on multimodal corpora including acted but also spontaneous expressions. We developed different computational models of emotions based on models in human science, such as CPM[13] or OCC[14]. Such model support a more expressive affective interaction than models based on basic emotions. These models are required for designing intuitive interactive virtual

[11] *Project ANR COMPARSE*
[12] *Huaa, J., Le Scanff, C., Larue, J., José, F., Martin, J.-C., Devillers, L., Filaire; E. (2014) Global stress response during a social stress test: impact of alexithymia and its subfactors. Psychoneuroendocrinology 08/2014; 50C:53-61.[Impact Factor = 5.591]*
[13] *Courgeon et al. AAMAS 2014 ; Scherer 2010*
[14] *Jones et al. AAMAS 2014; TARDIS project*

characters that need to consider in real-time the current situation to decide which emotion to express and how to express it in several modalities. We have applied this to the context of job interview simulation and training[15].

Research in Psychology has pointed the complex relations between emotion and cognition. Intelligent Agents do not need only models of emotions and personality but also need to be able to reason about the impact of their actions on the interlocutor's affects, so as to better anticipate reactions and adapt to the interaction context. In order to support repeated and long-term interactions, we developped the PERSEED model of personality which is based on a socio-cognitive approach to personality, combined with action selection strategies[16]. We have also proposed a BDI-based Theory of Mind model, which considers the interlocutor's beliefs, intentions and goals in a dialogue selection model[17]. The group considers the combination of these approaches with Artificial Intelligence models for dialogue systems such as the DISCO reactive HTN model[18]. These models will be used for conversation adaptation in dialogues between a human user and an artificial companion (virtual agent or robot).

The originality of our work lies in our focus on virtual agents that interact in real time with users, are realistic in terms of appearance and behaviors (up to Digital Doubles[19]), combine several nonverbal modalities and devices (facial expressions, postures, haptics, physiological measures, 3D, Virtual Reality), are inspired from studies in Psychology and Multimodal corpora, and are systematically evaluated using an experimental approach.

Left: sequential model of facial expressions of emotion based on the CPM model; Right: postural expression of complex emotions.

The interaction between human agents immersed in a scene makes use of the oral channel. It comprises speech, which represents its linguistic aspects, and voice, which is its acoustic carrier. Voice also carries several types of non-linguistic information such as the relative location of the interlocutors, their origin, age, gender physical and psychological state. We presently investigate Voice Strength, which is the main tool at the disposal of the agents to regulate their oral interactions.

We also consider the role of other modalities in affective virtual interaction which is a hot topic in remediation[20] and experimental study of different pathologies displaying social deficits. We work for

[15] *Porayska-Pomsta et al. UMAP 2014; TARDIS project*
[16] *Faure et al. ACII 2013*
[17] *Belkaid et Sabouret, IDGEI 2014*
[18] *In collaboration with C. Rich, WPI, USA*
[19] *Boukhris et al. CASA 2013*
[20] *Brunet, E., Oker, A., Martin, J.-C., Grynszpan, O., Jackson, P. Frontiers in Human Neurosciences. Research topic on Advances in Virtual Agents and Affective Computing for the Understanding and Remediation of Social Cognitive Disorders. http://journal.frontiersin.org/ResearchTopic/1850#overview*

example on the use of multimodal interfaces with autistic users (shared gaze with a virtual agent[21]) and the design of a trust game protocol with schizophrenia patients. Haptics is also considered as a main modality for conveying affects on its own or in complementarity with other modalities[22].

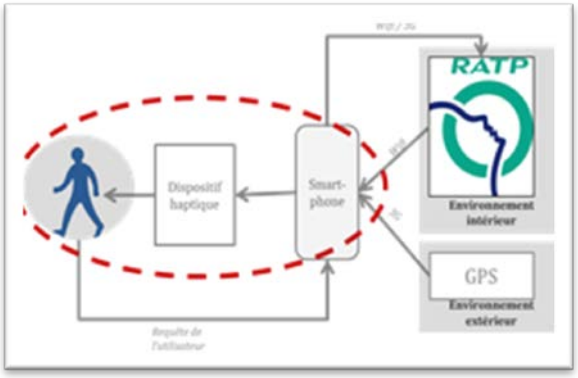
Personality and interindividual differences are also considered for the design of companions and personae in ergonomic studies[23].

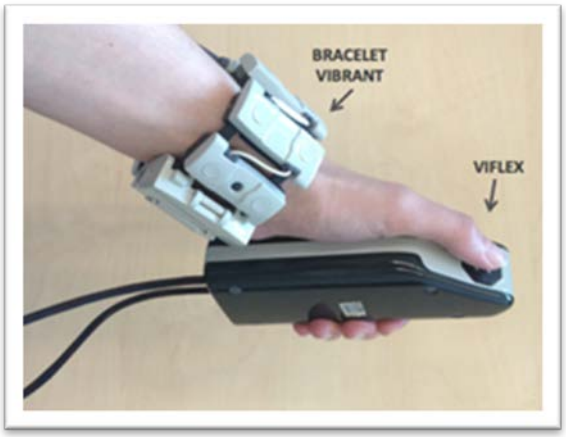
Topic 3 - Use, Activity, Behavior

Vincent Boccara, Céline Clavel, Marie-Paule Daniel, Virginie Demulier

This topic groups experimental and field studies oriented by consolidating the understanding of technology use from different theoretical background: psychology, ergonomics and professional didactic. Human uses of technology are analyzed from complementarity approaches based on the concept of "behavior" or "activity" (Falzon, 2013). We conduct research on this topic to create knowledge on how humans use technology, the behavior production process and the human activity toward comprehensive, explanatory or predictive approach.

Design and evaluation of haptic interactions for pedestrian navigation in urban environments (collaboration with CEA-LIST)[24]. This research relates to the design and to the evaluation of urban-navigation aids for pedestrians using haptic interactions. The analysis of the mobility needs, and of the resources currently used by pedestrians (visual interactions using medias such as maps, smartphones, etc…), has shed light on the factors underlying cognitive navigation activities: key phases of the displacement, information sources used, forms of expert knowledge of the network and of the itinerary, pace. At the end of this phase, we were able to identify cognitive activities leading to the acquisition of information, and interactions that might be used in the haptic modality: guiding, warning, and reassurance. A prototype concept involving a bracelet linked to a smartphone via a Bluetooth connection, has been evaluated[25].





[21] *Courgeon, M., Rautureau, G., Martin, J.-C., Grynszpan, O. (2014) Joint Attention Simulation using Eye-Tracking and Virtual Humans. IEEE TAC (Transactions on Affective Computing). Issue 3 - July-Sept. (vol. 5), pp. 238-250. [Impact Factor = 3.466]*

[22] *Tsalamlal, M. Y., Ouarti, N., Martin, J.-C., Ammi, M. (2014) Haptic Communication of Dimensions of Emotions using Air Jet Based Tactile Stimulation. JMUI (Journal on Multimodal User Interfaces), Special issue "Best of affective computing and intelligent interaction 2013 in multimodal interactions". [Impact Factor = 0.83]*

[23] *Le Bail C., Sennegon, B., Clavel C., Valentin A., Martin J-C. (2013) Ergonomie et théories de la personnalité pour les personas en conception de service. 48e Congrès de la SELF, 28-30 août 2013. Paris, France*

[24] *This research topic was explored in L. Brunet's PhD work, co-supervised by F. Darses & Marie-Paule Daniel (this work was performed in the context of the ANR Tictact project at CEA, and under the supervision of C. Mégard, in the LISA/LIST laboratory).*

[25] *Brunet, L. Doctorat*

Evaluation of information-seeking behaviors in pedestrians navigating in an urban environnement (in collaboration with Paris-Descartes University). The context of this research is the study of cognitive processes involved during the formation, memorization, and use of spatial representations for navigation. Initial experiments seek to improve our understanding of the interactions between spatial-information aids and actual information-seeking behaviors in the field. In particular, we are interested in the influence of the format of the source, which is used to form a mental representation of an itinerary, on the success of the navigation. The goal is to improve the design of navigation aids. One experiment, which was conducted in the town of Boulogne, examines the influence of the characteristics of two information sources (verbal description compared to a map featuring street names or landmarks) on itinerary-preparation behaviors. Recordings obtained using an eye-tracking device, which reflect visual-search behavior in the field, and indices such as the number of stops, errors, hesitations, etc… are currently being analyzed. Post-experiment interviews have been conducted in order to ask participants about their search-for-direction behavior during the experiment (auto confrontation method).

Connecting the different topics of the CPU group

Research questions often come across the borders of several of the topics described above. For example, training rescuers for team communication during crisis management in stressful situations involves the three topics identified above. This is the goal of the ANR VICTEAMS project (Virtual Characters for team Training: Emotional, Adaptive, Motivated and Social) which started in Novembre 2014. Several members of the CPU group collaborate with external partners (UTC, IRBA, CEA, BSPP, EVDG, Reviatech). The project aims at designing both computational and psycho-ergonomics models for virtual environments featuring virtual characters that are endowed with emotion, social and cognitive capabilities for training rescuer teams. CPU is contributing to the following tasks: 1) analyze, model and specify the work situations, collective awareness and natural decision making process, 2) specify the computational model of the future environment, 3) developing motor and 4) evaluation during the design process and with end users. The project will contribute to better understand the collective activity of rescuer teams in order to cope with crisis situations involving numerous injured persons, from work analysis approach oriented by the concept of “activity”. Key issues are: 1) anticipating the intended use by trainers and trainees in order to support the learning and training process of the collective dimension of their activity; 2) evaluating the effective uses of trainees and trainers of the virtual environment during the designing process (in order to orient the design decision) and, with the final prototype.

Highlights

- Collaboration with MIT Media Lab; Best Paper Award UBICOMP’2013 (5 Best Papers sur 392 submissions). M. E. Hoque, M. Courgeon, B. Mutlu, J-C. Martin, R. W. Picard, MACH: My Automated Conversation coacH. 15th International Conference on Ubiquitous Computing (Ubicomp), September 2013. http://newsoffice.mit.edu/2013/automated-coach-could-help-with-social-interactions-0614
- Paper on austism accepted in IEEE TAC Journal (Impact Factor 3,8). M. Courgeon, G. Rautureau, J.C. Martin, O. Grynszpan (2014) Joint Attention Simulation using Eye-Tracking and Virtual Humans, IEEE Transactions on Affective Computing. Issue 3 - July-Sept. (vol.5), pp. 238-250.
- The project VICTEAMS has been accepted for funding within the very selective 2014 generic call of the ANR. This project aims at designing a virtual system for training rescuers to manage a team in stressful situations (multiple victims). It involves an ergonomic approach (field studies), psychological studies and computational modeling.
- The TARDIS project (job interview simulation platform with an emotionnally intelligent virtual agent) is now used in more than 5 differente sites in France and the UK for professional training.

Staff

Permanent staff

Last name	First name	Position	Employer	HDR	Arrived	Left
Auvray	Malika	CR1	CNRS			
Boccara	Vincent	MC	Université Paris-Sud		01/09/2013	
Caillou	Sylvain	IE2	CNRS			
Clavel	Céline	MC	Université Paris-Sud			
Daniel	Marie-Paule	MCHC	Université Paris-Sud	HDR		
Demulier	Virginie	MC	Université Paris-Sud		01/09/2013	
Denis	Michel	DREM	CNRS	HDR		
Liénard	Jean-Sylvain	DREM	CNRS	HDR		
Martin	Jean-Claude	Pr2	Université Paris-Sud	HDR		
Sabouret	Nicolas	Pr2	Université Paris-Sud	HDR		
Tarroux	Philippe	Pr2	ENS Ulm	HDR		01/09/2013

PhD Students

Last name	First name	Arrived	Thesis defense	Ecole Doctorale	School / University
Arnold	Ludovic	01/01/2010	25/06/2013	EDIPS	Université Paris-Sud
Boukhris	Mehdi	02/05/2012		EDIPS	Université Paris-Sud
Brunet	Lucie	01/10/2011		SSMMH	Université Paris-Sud
Chevalier	Pauline	01/12/2013	30/11/2016	Polytechnique	ParisTech ENSTA
Darty	Kévin	01/10/2011		EDITE	UPMC
Faur	Caroline	01/10/2012		EDIPS	Université Paris-Sud
Focone	Florian	01/12/2012		SSMMH	Université Paris-Sud
Giraud	Tom	01/10/2011		EDIPS	Université Paris-Sud
Golsenne	Matthieu	01/10/2014		EDIPS	Université Paris-Sud
Huraux	Thomas	01/06/2012		EDITE	UPMC
Jaber	Ghazal	01/10/2010	18/10/2013	EDIPS	Université Paris-Sud
Kueviakoe	Kangni	01/10/2010	30/09/2014	EDIPS	Université Paris-Sud
Ould Ouali	Lydia	01/10/2014		EDIPS	Université Paris-Sud
Philip	Léonor	01/02/2012		SSMMH	Université Paris-Sud

Non permanent staff

Last name	First name	Position	Employer	Arrived	Left
André	Elisabeth	Invited professor	Université Paris-Sud	12/05/2014	30/06/2014
Arnold	Gabriel	CDD	CNRS	01/10/2013	30/06/2014
Arnold	Gabriel	CDD	CNRS	01/07/2014	30/09/2014
Ben Youssef	Atef	ATER	IUT Orsay	01/09/2014	31/08/2015
Dianoux	Camille	Vacations	CNRS	01/08/2013	30/11/2013
Dubuisson	Jean-Baptiste	IR	CNRS	01/01/2013	31/12/2013
Gomez Jauregui	David Antonio	ATER	Université Paris-Sud	01/09/2013	31/08/2015
Gras	Doriane	Chercheur	CNRS	01/03/2013	31/03/2013
Kueviakoe	Kangni	ATER	Université Paris-Sud	01/09/2013	31/08/2014

Last name	First name	Position	Employer	Arrived	Left
Kueviakoe	Kangni	ATER	Université Paris-Sud	01/09/2014	31/08/2015
Rendu	Christophe	IE	CNRS	01/11/2013	31/12/2013
Rendu	Christophe	IE	CNRS	01/05/2014	30/09/2014
Rich	Charles	Professeur invité	Université Paris-Sud	11/09/2013	31/08/2014

Internships

Last name	First name	Arrived	Left	Prepared degree	School / University
Francisco Delagis	Yohan	15/10/2012	27/03/2013	Master 1	Université Paris Ouest
Klagba	Carl	07/01/2014	31/05/2014	M1	Université Paris-Sud
Ouibrahim	Kahina	15/04/2013	15/09/2013	Master	ENS
Ould Ouali	Lydia	19/03/2014	19/09/2014	M2	Université Paris Dauphine

Indicators of scientific notoriety

Prizes and awards

- [Denis], Honorary doctorate (honoris causa) from the University of La Laguna (Spain) (Claustro's approval, June 2014)
- [Martin], Best Paper Award UBICOMP'2013.

Scientific events

- [Boccara], co-organizer, Symposium « Analyse du travail et métiers de la formation » in the 50^{e} congress of the SELF « Ergonomie et Société : quelles attentes, quelles réponse ?». Paris, Université de la Sorbonne, 28-30 août 2013.
- [Denis], Co-organizer, International Symposium "From Action to Concepts" (French Academy of Sciences) (Lille, 2013)
- [Denis], Vice-President, 28th International Congress of Applied Psychology (Paris, 2014)
- [Denis], Program Committee, International Conference Spatial Cognition (Bremen, Germany, 2014)
- [Sabouret], co-chair, 1st workshop in Intelligent Games for Empowerement and Inclusion (IDGEI), at ACE 2013, Chaina, Crete
- [Sabouret], co-chair, 2^{d} workshop in Intelligent Games for Empowerement and Inclusion (IDGEI), at IUI 2014, Haifa, Israel

Editorial activities

- [Boccara], reviewer, PISTES.
- [Boccara], reviewer, Activités.
- [Boccara], reviewer, Applied ergonomics.
- [Denis], Associate Editor, Journal of Mental Imagery (until 2013)
- [Denis], Editorial Board, Spatial Cognition and Computation (until 2013)
- [Denis], Editorial Board, Psychological Research
- [Martin], Editor-in-Chief, Springer Journal on Multimodal User Interfaces (JMUI)
- [Martin], Member of the Senior Programme Committee, IVA / ACII

Invited lectures, talks or seminars

- [Boccara], Une démarche d'analyse du travail pour la conception d'environnement virtuel de formation. Un exemple dans le domaine de l'aéronautique. Annual seminar « Âge et

Travail » of the Study and Research Center of age and population at work (CREAPT): Travailler et se former au fil du parcours professionnel, CNAM, Paris, 26-28 mai 2014.

- [Boccara], Analyse du travail pour la conception d'environnement virtuel de formation. Seminar "Ergonomie, Formation et développement". Chair of ergonomics, CNAM, Paris, 24 avril 2014.
- [Clavel], Enjeux de la prise en compte de la dimension affective dans le cadre de la conception d'IHM novatrices, 33e symposium 2014 de l'Association de Psychologie Scientifique de Langue Française, Rouen, 26-28 mai 2014.
- [Clavel] & [Ferey], Apports de l'ergonomie à la réalité virtuelle, apports de la réalité virtuelle à l'ergonomie, Journée d'étude en Ergonomie de l'ADEO, Université Paris-Sud, 1er février 2013.
- [Denis], "Spatial knowledge: An interdisciplinary challenge for cognitive scientists", First IAAP School on Applied Cognitive Research (Paris, 2013)
- [Denis], "Thinking and speaking about space: Research challenges for basic and applied cognitive science", GI Forum, Institute for Geoinformatics (Münster, Germany, 2013)
- [Denis], "Spatial knowledge and spatial discourse: A challenge for cognitive science", Linguistics Circle (Bangor, UK, 2013)
- [Liénard], Ce que nous disent les premières machines parlantes, 13e Journées d'étude des grammaires classiques, université de Mons, 10 juin 2014.
- [Liénard], A multicategorical view of the speech acoustic-phonetic decoding, Digicosme Research days, Gif sur Yvette, 8th july 2014.
- [Liénard], Interactions Voix-Parole, rôle et estimation quantitative de la Force de Voix, Atelier Sciences et Voix, Gipsa Lab, Mi2S, Grenoble, 22 octobre 2014.

Participation in expertise and administration of research

- [Denis], Jury Senior, Institut Universitaire de France (2013, 2014)
- [Denis], President, Committee "Apprentissages", Agence Nationale de la Recherche (2013)
- [Denis], President, Committee "Apprentissage, Education, Santé, Travail", Agence Nationale de la Recherche (2014)
- [Denis], President, Panel SH4-B, FP7, European Research Council, Advanced Grants (until 2013)
- [Denis], FP7, Marie Curie Action, IAPP (2013)
- [Denis], H2020, Marie Curie Action, ITN (2014)
- [Denis], Danish Council for Independent Research (2014)
- [Denis], Swiss National Fund, Temporary Backup Scheme, Starting Grants (2014)
- [Denis], Advisory Board, FP7 Project ForgetIT (2013-2016)
- [Sabouret], membre du panel Contint 2013

Ph.D and Habilitation committees

- [Denis], 1 HDR (president) (2013)
- [Liénard], 1 PHD (president)
- [Sabouret], 5 PhD and 1 HDR
- [Martin], 8 PHD

Position in Scientific Concils or Associations or Networks

- [Boccara], administrator, Association of the professor/researcher in Ergonomics.
- [Liénard], member of the administrative board, Institut Fredrik R. Bull, Les Clayes sous bois, 2012-2016.
- [Denis], President, Comité National Français de Psychologie Scientifique (2008-2016)
- [Denis], Secretary General, Comité Français des Unions Scientifiques Internationales (COFUSI / Académie des Sciences) (2013-2016)
- [Martin], elected member of the Executive Committee of the AAAC - (Association for the Advancement of Affective Computing : http://emotion-research.net/).

- [Sabouret], head of the “Artificial Companions, Affects and Interaction” (ACAI) workgroup (approx. 130 members in France)

Research conventions and contracts

Starting date	Ending date	Acronym	Catégorie	Funding agency/Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
15/12/10	30/11/14	PADE	Collaboration de recherche	ANR	Rilliard Albert	Rilliard Albert	National	163 513	JCJC
01/10/11	30/09/14	FRESCO	Collaboration de recherche	ANR	Auvray Malika	Auvray Malika	National	169 941	JCJC
01/01/12	31/03/15	COMPARSE	Collaboration de recherche	ANR	Amorim Michel-Ange	Martin Jean-Claude	National	165 468	EMCO
20/08/12	19/02/16	INGREDIBLE	Collaboration de recherche	ANR	De Loor Pierre	Martin Jean-Claude	National	165 600	CONTINT
01/10/12	31/03/16	MoCA	Collaboration de recherche	ANR	Duhaut Dominique	Martin Jean-Claude	National	160 887	CONTINT
01/11/13	30/04/17	NARECA	Collaboration de recherche	ANR	Pauchet Alexandre	Martin Jean-Claude	National	135 642	CONTINT
01/10/14	31/03/19	VICTEAMS	Collaboration de recherche	ANR	Lourdeaux Domitile	Boccara Vincent	National	239 353	CONTINT
01/10/11	31/03/15	ADN-TR	Collaboration de recherche	Région Ile de France	Guiard Cédric	Martin Jean-Claude	National	531 140	Pôle de compétitivité
01/10/12	30/09/15	HumanTouch		Digiteo	Ammi Mehdi	Ammi Mehdi	National	102 200	Encadrement de thèse
01/12/12	31/01/14	Prestation PIA-OSEO	Contrat de prestations de service	TESTAPIC	Martin Jean-Claude	Martin Jean-Claude	Industriel	52 174	
01/06/12	30/05/15		Collaboration de recherche	EDF	Sabouret Nicolas	Sabouret Nicolas	Industriel	30 000	CIFRE
01/09/12	31/12/14	TARDIS	Collaboration de recherche	UE	Sabouret Nicolas	Sabouret Nicolas	Europe	42 552	
01/10/14	31/03/17	CERNUM	Collaboration de recherche	EDF	Boccara Vincent	Boccara Vincent	Industriel	130 992	
24/09/13	30/06/14		Accord de secret	Orange	Sabouret Nicolas	Sabouret Nicolas	Industriel	-	
01/12/13	30/11/16		Collaboration de recherche	Région Ile de France	Tapus Adriana	Martin Jean-Claude	National	-	Encadrement de thèse

Scientific publications

Doctoral theses and HdR

1. Brunet, L. *Etude ergonomique de la modalité haptique comme soutien à l'activité de déplacement piéton urbain - Un projet de conception de produit innovant,* 2014, thèse de l'Université Paris-Sud. Soutenue à Orsay, le 15/12/2014, 216 p.

Articles in peer reviewed scientific journals

1. Arnold, G. and M. Auvray, *Perceptual learning: Tactile letter recognition transfers across body surfaces.* Multisensory Research, 2014. **27**: pp.71-90.
2. Avraamides, M., A. Galati, F. Pazzaglia, C. Meneghetti, and M. Denis, *Encoding and updating spatial information presented in narratives.* Quarterly Journal of Experimental Psychology, 2013. **66** (4): pp.642-670.
3. Buisine, S., M. Courgeon, A. Charles, C. Clavel, J.-C. Martin, N. Tan, and O. Grynszpan, *The role of body posture in the recognition of emotion in contextually-rich scenarios.* International Journal of Human-Computer Interaction, 2013. **30** (1): pp.52-62.

4. Castellano, G., L. Riek, C. Peters, K. Karpouzis, J.-C. Martin, and L.-P. Morency, *Introduction to the special issue on affective interaction in natural environments.* ACM Transactions on Interactive Intelligent Systems (TiiS), 2013. **2** (1): pp.1-4.
5. Chen, W., C. Clavel, N. Ferey, and P. Bourdot, *Perceptual Conflicts in a Multi-Stereoscopic Immersive Virtual Environment: Case Study on Face-to-Face Interaction through an Avatar.* Presence: Teleoperators and Virtual Environments, 2014. **23** (4): pp.40.
6. Courgeon, M. and C. Clavel, *MARC: a Framework that Features Emotion Models for Facial Animation during Human-Computer Interaction.* Journal on Multimodal User Interfaces, 2013. **7** (4): pp.311-319.
7. Demulier, V., Y. Stéphan, E. Fouquereau, S. Chevalier, and C. Le Scanff, *Planification de l'âge du départ à la retraite professionnelle : contribution de l'ouverture aux expériences. Psychologie du Travail et des Organisations.* PTO, 2014. **20** (1): pp.19.
8. Denis, M., C. Mores, D. Gras, V. Gyselinck, and M.-P. Daniel, *Is memory for routes enhanced by an environment's richness in visual landmarks?* Spatial Cognition and Computation, 2014. **14** (4): pp.284-305.
9. Gaffary, Y., M.V. Eyharabide, J.-C. Martin, and M. Ammi, *Clustering approach to characterize haptic expressions of emotions.* ACM Transactions on Applied Perception, 2013. **10** (4): pp.18p.
10. Hua, J., C. Le Scanff, J. Larue, F. José, J.-C. Martin, L. Devillers, and E. Filaire, Global stress response during a social stress test: Impact of alexithymia and its subfactors. Psychoneuroendocrinology, 2014. (50): pp.53-61.
11. Leroux, C., O. Lebec, M.W. Ben Ghezala, Y. Mezouar, L. Devillers, C. Chastagnol, J.-C. Martin, V. Leynart, and C. Fattal, ARMEN: Assistive robotics to maintain elderly people in natural environment. IRBM, 2013. 34 (2): pp.101-107.
12. Martin, J.-C. and M. Courgeon, *MARC: a Framework that Features Emotion Models for Facial Animation during Human-Computer Interaction.* Journal on Multimodal User Interfaces, 2013. pp.311-319.
13. Martin, J.-C., M. Courgeon, G. Rautureau, and O. Grynszpan, *Joint Attention Simulation using Eye-Tracking and Virtual Humans.* IEEE Transactions on Affective Computing (TAC), 2014. (3): pp.238-250.
14. Martin, J.-C., Y. Gaffary, V. Eyharabide, and M. Ammi, *The impact of combining kinesthetic and facial expression displays on emotion recognition by users.* International Journal of Human Computer Interaction (IJHCI), 2014. **30** (11): pp.904-920.
15. Picinali, L., A. Afonso, M. Denis, and B. Katz, *Exploration of architectural spaces by the Blind using virtual auditory reality for the construction of spatial knowledge.* International Journal of Human-Computer Studies, 2014. **72** (4): pp.393-407.

Books & chapters in books

1. Chastagnol, C., C. Clavel, M. Courgeon, and L. Devillers, *Designing an emotion detection system for a socially-intelligent human-robot interaction*, in *Towards a Natural Interaction with Robots, Knowbots and Smartphones, Putting Spoken Dialog Systems into Practice*, J. Mariani, et al., Eds. 2013, Springer.
2. Denis, M. and G. Fernandez, *The processing of landmarks in route directions*, in *Representing space in cognition: Interrelations of behaviour, language, and formal models*, J. Wiener T. Tenbrink and C. Claramunt, Eds. 2013, Oxford University Press. pp. 42-55.
3. Gallay, M., M. Denis, and M. Auvray, Navigation assistance for blind pedestrians: Guidelines for the design of devices and implications for spatial cognition, in Representing space in cognition: Interrelations of behaviour, language, and formal models, J. Wiener T. Tenbrink and C. Claramunt, Eds. 2013, Oxford University Press. pp. 244-267.

Conferences with proceedings and review committee

1. Arnold, G., J. Hartcher-O Brien, C. Spence, and M. Auvray. *The cost of adopting and adapting tactile frames of reference*. in *International Multisensory Research Forum*. 2013. Jerusalem, Israel.
2. Auvray, M. *Replacing one sense by another: Learning to use sensory substitution devices*. in *International Scientific Conference Restauración Neurológica*. 2014. La Habana, Cuba.
3. Ben Youssef, A., N. Sabouret, and S. Caillou. *Subjective evaluation of a BDI-based theory of Mind model*. in *Workshop Affects, Compagnons Artificiels et Interaction*. 2014. Rouen, France. 6.
4. Brousmiche, K.-L., J.-D. Kant, and N. Sabouret. *Modélisation de l'impact des croyances et de la communication sur la formation et la dynamique des attitudes : une approche multi-agents*. in *Journées Francophones sur les Systèmes Multi-Agents*. 2014. Valence, France. 10.
5. Brousmiche, K.-L., J.-D. Kant, N. Sabouret, S. Fournier, and F. Prenot-Guinard. *Modelling the impact of beliefs and communication on attitude dynamics: a cognitive agent-based approach*. in *Conference of European Social Simulation Association*. 2014. Barcelona, Espagne. 12.

6. Brousmiche, K.-L., J.-D. Kant, N. Sabouret, and F. Prenot-Guinard. The role of emotions on communication and attitude dynamics: an agent-based approach. in World Congress on Social Simulation. 2014. Sao Paulo, Brésil. 12.
7. Charlet, D., C. Barras, and J.-S. Liénard. *Impact of overlapping speech detection on speaker diarization for broadcast news and debates*. in *IEEE International Conference on Acoustics, Speech and Signal Processing*. 2013. Vancouver, Canada. 5p.
8. Courgeon, M., C. Clavel, and J.-C. Martin. *Modeling Facial Signs of Appraisal During Interaction: Impact on Users' Perception and Behavior*. in *International Conference on Autonomous Agents and Multi Agents Systems*. 2014. Paris, France: IFAAMAS/ACM. 765--772.
9. Darty, K., J. Saunier, and N. Sabouret. *A method for semi-automatic explicitation of agent's behavior: application to the study of an immersive driving simulator*. in *International Conference on Agents and ARTificial intelligence*. 2014. Angers, France. 11.
10. Darty, K., J. Saunier, and N. Sabouret. Analyse des comportements agents par agrégation aux comportements humains. in Journées Francophones sur les Systèmes Multi-Agents. 2014. Valence, France. 10.
11. Demulier, V., Y. Stéphan, and C. Le Scanff. *Planification de la carrière future parmi les étudiants STAPS : rôle des traits de personnalité*. in *Association des Chercheurs en Activités Physiques et Sportives*. 2013. Grenoble, France. 269-270.
12. Deroy, O., I. Fasiello, V. Hayward, and M. Auvray. *Audio-tactile crossmodal correspondences*. in *International Multisensory Research Forum*. 2013. Jerusalem, Israel: Multisensory Research. 73.
13. Dubois, M., P. Tarroux, and E. Frenoux. Using n-grams models for visual semantic place recognition. in International Joint Conference on Computer Vision Theory and Applications. 2013. Barcelona, Spain. 239_1-239_8.
14. Faur, C., C. Clavel, S. Pesty, and J.-C. Martin. *PERSEED: a Self-based Model of Personality for Virtual Agents Inspired by Socio-cognitive Theories*. in *5th International Conference on Affective Computing and Intelligent Interaction, ACII 2013*. 2013. Geneva, Switzerland: IEEE. 467-472.
15. Focone, F., V. Demulier, E. Bevacqua, T. Giraud, B. Isableu, and J.-C. Martin. *A database of full body virtual interactions annotated with expressivity scores*. in *9th International Conference on Language Resources and Evaluation*. 2014. Reykjavik. 6.
16. Focone, F., T. Giraud, V. Demulier, C. Le Scanff, B. Isableu, and J.-C. Martin. *Evaluation d'un outil low-cost pour le recueil de données cinématiques par l'analyse fréquentielle du signal de l'articulation du genou*. in *Association des Chercheurs en Activités Physiques et Sportives*. 2013. Grenoble, France. 543-544.
17. Focone, F., I. Stankovic, and B. Popovic. *Influence of agent behaviour on human-virtual agent body interaction*. in *International Conference on Speech and Computer*. 2014. Novi Sad, Serbia. 8.
18. Gaffary, Y., M.V. Eyharabide, M.Y. Tsalamlal, J.-C. Martin, and M. Ammi. *Comparison of Statistical Methods for the Analysis of Affective Haptic Expressions*. in *International Workshop on Haptic and Audio Interaction Design*. 2013. Daejeon, Korea. 10p.
19. Girard, A., M. Auvray, and M. Ammi. *Collaborative Metaphor for Haptic Designation in Complex 3D Environments*. in *ACM Symposium on Applied Perception*. 2014. Vancouver, British Columbia, Canada. 31-37.
20. Girard, A., Y. Bellik, M. Auvray, and M. Ammi. *Visuo-Haptic tool for collaborative adjustment of selections*. in *International Workshop on Haptic and Audio Interaction Design*. 2013. Daejeon, Korea. 1-10.
21. Girard, A., Y. Bellik, M. Auvray, and M. Ammi. *Collaborative approach for dynamic adjustment of selection areas in polygonal modelling*. in *IEEE Symposium on 3D User Interfaces*. 2013. Orlando, Florida. 1-2.
22. Giraud, T., V. Demulier, F. Focone, B. Isableu, and J.-C. Martin. *A protocol for studying the impact of positive vs. negative emotions on a predefined sequence of full-body movements*. in *Consortium of European Research on Emotion Conference*. 2014. Berlin, Deutschland. 1.
23. Giraud, T., F. Focone, B. Isableu, J.-C. Martin, and V. Demulier. *Toward an expressive virtual coach: fitness movements in emotional and motivational contexts*. in *HCI and sports*. 2014: ACM. 4.
24. Giraud, T., D.A. Gomez Jauregui, J. Hua, B. Isableu, E. Filaire, C. Le Scanff, and J.-C. Martin. *Assessing Postural Control for Affect Recognition using Video and Force Plates*. in *International Conference on Affective Computing and Intelligent Interaction*. 2013. Genève. 109 - 115.
25. Giraud, T., M. Soury, J. Hua, A. Delaborde, M. Tahon, D.A. Gomez Jauregui, M.V. Eyharabide, E. Filaire, C. Le Scanff, L. Devillers, B. Isableu, and J.-C. Martin. *Multimodal expressions of stress during a public speaking task*. in *International Conference on Affective Computing and Intelligent Interaction*. 2013. Genève, Suisse. 417-422.
26. Gomez Jauregui, D.A. and J.-C. Martin. *Evaluation of Vision-based Real-Time Measures for Emotions Discrimination under Uncontrolled Conditions*. in *Emotion recognition in the wild challenge and workshop*. 2013. Sydney, Australia. 17-22.
27. Gomez Jauregui, D.A., L. Philip, C. Clavel, S. Padovani, M. Bailly, and J.-C. Martin. *Video Analysis of Approach-Avoidance Behaviors of Teenagers Speaking with Virtual Agents*. in *15th International Conference on Multimodal Interfaces*. 2013. Sydney, Australia. 189-196.

28. Hartcher-O Brien, J., C. Spence, and M. Auvray. *At the tip of the fingers: The role of orientation and position on the reference frames used to interpret ambiguous stimuli presented to the hand*. in *International Multisensory Research Forum*. 2013. Jerusalem, Israel: Multisensory Research. 83-84.
29. Jones, H., M. Chollet, M. Ochs, N. Sabouret, and C. Pelachaud. *Expressing social attitudes in virtual agents for social coaching*. in *International Conference on Autonomous Agents and Multiagent Systems*. 2014. Paris. 2.
30. Jones, H., M. Chollet, M. Ochs, N. Sabouret, and C. Pelachaud. *Expressing social attitudes in virtual agents for social coaching*. in *Workshop Affects, Compagnons Artificiels et Interaction*. 2014. Rouen, France. 6.
31. Jones, H. and N. Sabouret. *Affective model with strategic intentions based on Theory of Mind*. in *International Workshop on Emotion Representations and Modelling for HCI Systems*. 2013. Sydney. 11.
32. Jones, H., N. Sabouret, and A. Ben Youssef. *Strategic intentions based on an affective model and a simple theory of mind*. in *Workshop Affects, Compagnons Artificiels et Interaction*. 2014. Rouen, France. 6.
33. Liénard, J.-S. *Interactions voix-parole: rôle et estimation quantitative de la force de voix*. in *Atelier Sciences et Voix*. 2014: Université de Grenoble.
34. Liénard, J.-S. and C. Barras. *Fine-grain voice strength estimation from vowel spectral cues*. in *Annual Conference of the International Speech Communication Association*. 2013. Lyon, France. 128-132.
35. Liénard, J.-S. and C. Barras. *Étude des voyelles et de la force de voix par analyse discriminante*. in *Journées d'Etude sur la Parole*. 2014. Le Mans, France. 9.
36. Mbengue, C., D.A. Gomez Jauregui, and J.-C. Martin. *CONTACT: A Multimodal Corpus for Studying Expressive Styles and Informing the Design of Individualized Virtual Narrators*. in *6th Workshop on Intelligent Narrative Technologies*. 2013. Boston, USA. 86-88.
37. Porayska-Pomsta, K., P. Rizzo, I. Damian, T. Baur, E. André, N. Sabouret, H. Jones, K. Anderson, and E. Chryssafidou. *Who's afraid of job interviews? Definitely a question for User Modelling*. in *Conference on User Modeling, Adaptation and Personalization*. 2014. Aalborg, Denmark. 12.
38. Sabouret, N. and M. Belkaid. *A logical model of Theory of Mind for virtual agents in the context of job interview simulation*. in *International Workshop on Intelligent Digital Games for Empowerment and Inclusion*. 2014. Haifa, Israel. 8.
39. Sabouret, N., K. Darty, and J. Saunier. *Agents behavior semi-automatic analysis through their comparison to human behavior clustering*. in *International Conference on Intelligent Virtual Agents*. 2014. Boston, USA: Springer-Verlag. 10.

40. Sabouret, N., T. Huraux, and Y. Haradji. *A Multi-Level Model for Multi-Agent Based Simulation*. in *International Conference on Agents and ARTificial intelligence*. 2014. Angers, France. 8.
41. Sabouret, N., T. Huraux, and Y. Haradji. *Un modèle multi-niveau pour simuler l'activité humaine dans le contexte de la consommation énergétique résidentielle*. in *Rencontres des Jeunes Chercheurs en Intelligence Artificielle*. 2014. Rouen, France. 6.
42. Sabouret, N., H. Jones, I. Damian, T. Baur, E. André, K. Porayska-Pomsta, and P. Rizzo. *Interpreting social cues to generate credible affective reactions of virtual job interviewers*. in *International Workshop on Intelligent Digital Games for Empowerment and Inclusion*. 2014. Haifa, Israel. 8.
43. Sabouret, N., H. Jones, M. Ochs, M. Chollet, and C. Pelachaud. *Expressing social attitudes in virtual agents for social training games*. in *International Workshop on Intelligent Digital Games for Empowerment and Inclusion*. 2014. Haifa, Israel. 8.
44. Stankovic, I., P. De Loor, V. Demulier, A. Nédélec, and E. Bevacqua. *The INGREDIBLE database: A first step toward dynamic coupling in human-agent body interaction*. in *International Conference on Intelligent Virtual Agents*. 2013. Edinburgh, UK: Springer. 430-432.
45. Tsalamlal, M.Y., N. Ouarti, and M. Ammi. *Psychophysical study of air jet based tactile stimulation*. in *Joint EuroHaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems (World Haptics Conference)*. 2013. Deajeon, South Korea: IEEE. 639-644.

Conferences without proceedings, workshops

1. Auvray, M. *Replacing one sense by another: learning to use a sensory substitution device*. in *Neuroeng*. 2014. Adelaide, Australia.
2. Auvray, M. *Perceptual learning of tactile letters transfers across body surfaces*. in *Australasian Neuroscience Society*. 2014. Adelaide, Australia.
3. Denis, M. *Spatial knowledge: An interdisciplinary challenge for cognitive scientists*. in *First IAAP Spring School on Applied Cognitive Research*. 2013: International Association of Applied Psychology.
4. Denis, M. *Pointing to arrows: A unique device for visual communication and navigational assistance*. in *European Workshop on Imagery and Cognition*. 2014. Paphos, Cyprus.

5. Faur, C., C. Clavel, and J.-C. Martin. *La personnalité comme catalyseur de l'intercompréhension entre un utilisateur et un agent virtuel : le modèle PERSEED*. in *III 2013 - Intercompréhension de l'intraspécifique à l'interspécifique*. 2013. Lorient, France.
6. Harkouken, K., N. Sabouret, and J.-Y. Donnart. *An ontology for semantic representation of an urban virtual environment*. in *International Conference on Artificial Intelligence*. 2013. Las Vegas, USA. 1-6.
7. Pécune, F., C. Faur, M. Ochs, C. Clavel, C. Pelachaud, and J.-C. Martin. *Modélisation de l'influence de la personnalité d'un compagnon artificiel sur ses attitudes sociales*. in *Workshop Affects, Compagnons Artificiels et Interaction*. 2014. Rouen. 6.
8. Philip, L., C. Clavel, M. Courgeon, and J.-C. Martin. *An affective computing platform for investigating the role of pedagogical feedback in computer mediated collaboration*. in *Alpine Rendez-Vous (ARV 2013) Workshop on Tools and Technologies for Emotion Awareness in Computer-Mediated Collaboration and Learning*. 2013: Université de Genève. 2p.

VENISE

Virtual Environment for Immersive Simulation and Experiments

PATRICK BOURDOT

VENISE (Virtual & augmented ENvIronments for Simulation and Experiments) is the research group of LIMSI-CNRS in Virtual and Augmented Reality (V&AR). Our research aims at developing methods and tools to make immersive and collaborative interactions more "natural" or more intuitive, either in purely virtual worlds or in virtual worlds coupled to real environments. We strive at making our models generic enough so that they apply to a large range of immersive environments, such as collaborative (RAVE, CAVE, Workbench ...), individual (HMD, see-through ...), or multi-sensorimotor (stereoscopic, 3D audio, haptic…). We develop and test the usefulness of our concepts in the context of different application areas.

The first research topic is the study of **interaction models in V&AR**. This topic covers several types of problems, from the design of interactive paradigms for dedicated tasks (control of virtual navigations, sensorimotor rendering...), up to the development of intelligent systems for the multimodal supervision of immersive interactions, for individualized or collaborative experiments, in Virtual or Mixed Reality. In this respect, the question of the task is ubiquitous, because we systematically need to justify the added value of V&AR with respect to already prevalent HCI techniques. One bottle-neck of V&AR interactions is real-time processing, which consequently raises questions about **data models or simulations** dedicated to the target applications. This second research topic aims at studying means of creating a continuum between the models underlying specific applications and the available platforms for the implementation of such applications in V&AR. We mainly work on three approaches, which are sometimes used concurrently within the same applicative field. The first one concerns the in-depth analysis of data structures (assumed to be massive and complex) to take full advantage of V&AR data rendering techniques. The second approach is interested in real-time algorithms to create realistic virtual simulations dedicated to V&AR. The third one is to develop specific models to better integrate a given application within a V&AR framework.

The research of the group is showcased in the development of several demonstrators, some being dedicated to ergonomics studies, others being more oriented towards the analysis of usage scenarios related to different application domains. During this activity period, three classes of V&AR applications have been studied: scientific applications (data exploration and simulation in Computer Fluid Dynamics and in Structural Biology), remote control of vehicles with an Augmented Virtuality approach, and finally Virtual Reality for Product Lifecycle Management.

In addition to fundamental research on V&AR, part of our activity has been devoted, from 2000 to 2009, to the completion of the specification and the construction of our large multi-sensorimotor and multiuser CAVE-like equipment, named EVE (Evolutive Virtual Environment). Co-funded by CNRS and the RTRA Digiteo, and currently supported by the Equipex French government program (DIGISCOPE project labelled in 2010) and by the DIGIPODS project (SESAME 2012 of the Ile de France council), the EVE system consists in a rear-projected floor of 13 m², and three screens of nearly 5 meters high. A double-stereoscopy technology allows the management of an exact visual depth perception for two user groups, so as to study co-localized immersive collaboration. 3D audio renderings of high fidelity are also implemented, thanks to acoustic constraints enforced on the

projectors and the hall that hosts this immersive system. Coupled with haptic facilities the full setup is therefore a unique scientific tool for the study of multi-sensorimotor immersive interactions. In 2013, these haptic facilities have been reinforced via the installation of the Scale One / Boom 3D of Haption. This equipment combines a 6 DoF Virtuose haptic arm with a 3 DoF translational robotic device, which makes possible now to address haptic rendering on most of the surface of the immersive workspace. Moreover, the EVE system can morph into a number of geometric configurations, and in particular, to be divided into two separate Virtual Environments. It thus allows to compare co-localized and remote collaboration paradigms, which is one of our main scientific focus in the DIGISCOPE Equipex project (see below).

At the European level, we are involved in EuroVR, the European Association of V&AR that exploits the outcomes of INTUITION (Network of Excellence on vIrtual reality aNd virTUal environments applIcatIONs for future workspaces) a former NoE of the FP6 EC program (IST) within which we coordinated the activity of four CNRS laboratories. Founding member of this association, we are also member of its Executive Board, where we are in charge of the research animation within EuroVR, by managing the launching and support of Special Interest Groups (SIGs). In this context, and following the successes of EuroVR EVE-2010 and AFRV 2010 meetings, we have co-organized with CEA-LIST the 5th Joint Virtual Reality Conference of EUROGRAPHICS and EuroVR in December 2013 (http://jvrc2013.sciencesconf.org/). 135 participants attended to JVRC 2013, coming from 19 nations of Europe, Asia, and North America.

At the national level, thanks to our former partnership in the ANR Perf-RV2 project, the VENISE group has developed a close collaboration with PSA Peugeot-Citroën on product design in immersive situations (topic 2). In this context, a CIFRE fellowship was obtained from ANRT in May 2011 to support the PhD of *Pierre Martin*, which was defended in July 2014. Since 2010, we are involved for ten years in the Equipex DIGISCOPE project. This project, which was initiated on existing equipments (namely, the WILD device of LRI, and the EVE system of the VENISE group), aims at creating on the Plateau de Saclay a unique network of equipment and expertise for the visualisation and collaborative interaction with massive and complex data. Our scientific contribution in this project covers multi-sensorimotor immersive interactions, up to co-localized and remote immersive collaborations. Regarding these topics we are continuing the partnership with the LSI team at CEA-LIST, started during the former SIMCoD project supported by the RTRA DIGITEO. In addition, in September 2013, both teams have obtained a joint funding from the same institute to support the fixed-term research contract of Nicolas Ladévèze to work on collaborative haptics (cf. IDCoM project). Although mainly academic, this project also associates industrial partners and in particular PSA Peugeot-Citroën thus reinforcing our existing collaboration.

At the local level, the members of the team were involved in the 2010-2013 habilitation project of the Master course in Computer Science of the University Paris-Sud. We proposed a number of courses related to the V&AR field to the Interaction speciality of this Master, including one mandatory teaching module (lectures + tutorials). This Interaction Master speciality has now been running for the last four years and some students have subsequently begun a PhD in the team.

Research activities

Topic 1 « Interaction Models for V&AR »

***P. Bourdot*, N. Férey, D. Touraine, J.-M. Vézien,** *W. Chen, P. Martin, N. Ladévèze, Q. Mallik, A. Tseu.*

Interactive paradigms for Virtual Navigations

This first subtopic addresses a basic problem for any V&AR application, i.e. how to travel within immersive environments. During this period, we focused our work on 6DoF navigation techniques, and the physiological and cognitive issues of such a task.

Research on virtual navigation controlled by 6DoF tracking was initiated many years ago during the PhD of *D. Touraine*. We proposed a very powerful interactive paradigm that can exploit any 6 DoF tracker attached anywhere on the user body. This signal is used like a 6 DoF wheel for the speed control of a virtual vehicle in translation and rotation. From the beginning we applied this intuitive technique to the hand or the head of users, hence the acronym HCNav (Hand/Head Controlled Navigation system) was chosen. Previous ergonomic studies had already demonstrated that applying HCNav to the head rather than the hand was more suitable, providing a concrete vestibular stimulation to the users during their virtual navigation tasks.

Because such navigation technique may be useful to manage co-habitation of users in multi-stereoscopic immersive environments, the PhD work of *Weiya Chen* started by a study on the added value of the HCNav approach in terms of presence and cybersickness. The results of this experiment, led in collaboration with the ergonomist *Julien Nelson* (Paris Descartes University) and one of his Master student *Anthony Plancoulaine*, has been published in the proceedings of the ACM VRST 2013 international conference. Another experiment with this navigation technique has been led with two other Ergonomic students, *Clémence Blanchet and Chahrazade Oumzai*, to study the effects of scene complexity on these physiological and cognitive issues. A paper journal is in preparation which points that cybersickness increases when visual information on space orientation is weak, and this is more critical when the navigation technique uses a bodily involvement, probably because of an augmentation of the perceptual conflicts between the different sensori-motor channels.

On the other hand, according to the PhD focus *of Mikael Trellet* which is also reported in topic 2, work has been led to design navigation paradigms dedicated to structural biology. These paradigms are based on the specificity of molecular content and expert task in the molecular science field. Indeed, most of work in virtual environments concerning navigation is dedicated to realistic virtual scenes and navigating into abstract scientific content stays a crucial issue, in order to keep a good spatial awareness in desktop context and to avoid cybersickness.

Sensorimotor channels for Immersion

This subtopic aims at developing new metaphors and interactive paradigms based on the three main sensorimotor channels of V&AR, namely visual stereoscopy, 3D audio, and haptics. The focus here is not the realistic rendering of scenes but rather the study of the contribution of these 3D feedback modalities towards facilitating user interactions and collaborations during immersive applications.

This research was initiated within the former ANR "CoRSAIRe" project and was the subject of the PhD thesis of *Bob Ménélas*. The first part of this work consisted in studying the role of haptics in the exploration of large data sets, from which we proposed different multimodal methods (combining haptics and 3D audio) dedicated to facilitate the exploration process. The second part of his PhD applied the generic approaches developed previously on the exploration of a specific data set derived from CFD simulations in an open cavity (related to topic 2). During this activity period we finalized, with *Bob Ménélas* (former PhD student of the VENISE group, now Assistant professor in Canada) and *B. Katz* (AA group), a paper in the Journal of Multimodal User Interfaces (Springer) on combining haptics and 3D audio for identification, localization, and selection of targets in immersive situations.

On the other hand, with the installation of the Scale One / Boom 3D of Haption in the EVE system, a new research issue has been opened on usability of this haptic equipment, and more generally, for the safety of users when they are in immersive collaboration thanks to the multi-stereoscopic

technology. Actually, we have observed that an ultimate additional DoF is required to make this equipment more suitable to CAVE-like system, to allow an optimal positioning of the device with respect to the user point of view. That supposes to modify in real time the haptic device positioning according to the head tracking of the user, and not only on his/her hand motion, like it is already managed by this equipment. *Nicolas Ladévèze* is working on this issue which is relevant for collaborative haptics research program planned in the IDCoM project. We are investigating presently a paradigm close to the HCNav technique which can be applied to visuo-haptic rendering. If this navigation approach succeeds, it will have the advantage to propose a global solution for the management of several users, for visual co-habitation in multi-stereoscopy, as well as for managing the safety of collaborators who didn't use the haptic device.

Software platform for sensorimotor immersion

This subtopic aims at developing new metaphors and interactive paradigms based on the three main sensorimotor channels of V&AR, namely visual stereoscopy, 3D audio, and haptics. The focus here is not the realistic rendering of scenes but rather the study of the contribution of these 3D feedback modalities towards facilitating user interactions and collaborations during immersive applications. From 2011, *D. Touraine* has led the LIMSI involvement in the European network developing BlenderVR (previously named BlenderCAVE), a system based on the 3D animation Open Source Software Blender 3D and the Blender Game Engine (BGE). Launched by *Jorge Gascòn Pérez* (King Juan Carlos University, Madrid, Spain), in association with *Fabrizio Bazzurri* (Nu.m.i.d.i.a. Srl, Rome, Italy) and *Julian Adenauer* (Zentrum Mensch-Maschine-Systeme - Technische Universität Berlin, Germany), BlenderVR aims at the real-time rendering of Blender scenes into CAVE-like environments.

Thanks to the collaboration of the VENISE and AA groups, BlenderVR now aggregates most features of LIMSI's Virtual Environments (i.e. EVE system and SMART-I2). First, VENISE integrated multi-user stereoscopic visual rendering and, with the help of the AA group, spatialized sound through ambisonic, binaural and Wave Field Synthesis methods. In addition, as BlenderVR also uses VRPN to provide VR device interactions, VENISE developed several drivers for VRPN, mainly for Linux input devices, the SPHINX voice recognition system a 3D tracking simulator. Our main interest for contributing to BlenderVR, is to leverage this Open Source framework for prototyping various interaction paradigms designed for immersive interactions.

With the BlenderVR platform novel experiments to evaluate the HCNav system were performed (see above). Moreover, BlenderVR is used by *Weiya Chen* for his PhD work to study the management of several users during co-localized immersive collaboration. From September 2014, the VENISE group is also collaborating with *Dali Felinto*, a fixed-term research engineer funded by the AA group. Our interest is to extend to HMD-like setups the visual devices supported by BlenderVR with the same software facilities already implemented for CAVE-like systems, in such way that we may compare a number of interactive techniques of immersive collaboration in co-localized or remote situations. Finally, the feasibility of the integration of haptic rendering has been also studied by *Nicolas Ladévèze*, but its implementation not yet launched. This should be planned as soon as possible, to enable experiments on remote multisensory collaborations in the context of the DIGISCOPE project.

Supervision of Multimodal and Collaborative Immersion

Our work on multimodal fusion in immersive situation has been extended during the previous period to the immersive interactions in Collaborative Virtual Environment (CVE). The main popular showcase of this work has been the MalCoMIICs application (Multimodal and Co-localized Multi-user Interactions for Immersive Collaborations), whose video and several papers were selected and presented at VR 2011 and 3DUI 2011, two prominent international conferences in the VR research field. A Scale One / Boom 3D version of this application has been shown during the demonstration sessions of JVRC 2013. Moreover, an extended presentation of this work was published last February

in the proceedings of The Engineering Reality of Virtual Reality at IS&T/SPIE Electronic Imaging 2014 conference (San Francisco, US). The impressive operational results of our work highlighted the need of semantisation of contents and interactive context events using a common formalism in order to better understand users' intentions in a collaborative context. This approach will provide adaptable interfaces able to learn user preferences from his/her interaction and behaviour, and will make it possible high level annotations during the VR experience. Preliminary works about this approach was led during the internships of *Qasim Mallik* and *Antony Tseu*.

Apart from multimodal supervision of immersive collaborations, the VENISE group initiated work on a number of problems linked to co-localized immersion, with the collaboration of ergonomists (*Céline Clavel* of the CPU group, and *Françoise Darses* from IRBA, the French Army Biomedical Research Institute). This is one of the main focuses of the PhD that *Weiya Chen* started in September 2012. A first class of problems is how to manage the cohabitation of users in the immersive setup. We are currently designing a specific manager of the users' viewpoints, in charge of avoiding mutual occlusions of the stereoscopic views. In addition, this manager must also prevent physical collisions between users when they don't look at each other. A first solution on these issues has just been accepted for the next IEEE VR conference planned in March 2015. This work is based on a cinematic approach, which is an extension of our previous works on the HCNav navigation technique we spoke about above. A second class of problems is the possible visual-audio incoherencies the users can experience between the real world and its virtual counterpart. On this issue an experiment to examine the perceptual conflicts generated by the dual-presence of the real and virtual visual and audio stimuli was crafted. In a two-user scenario, participants performed an object-picking task according to three types of instructions (verbal, gestural or multimodal instructions) given by an experimenter. This co-located experimenter was also virtually present by an avatar in the virtual world to enable face-to-face interactions with the participants. The results showed that users had an a priori choice of collaborator (avatar or real person) and this choice did not change under different experimental conditions. Also, perceptual conflicts had an impact on users' performance in term of task completion time. Finally, performance of users is better with verbal instructions, rather than multimodal or gestural ones. This study has been accepted in PRESENCE, the first journal in the field of Teleoperators and Virtual Environments, and should be published before the end of 2014 (Volume 23, Issue 4). We now plan to study the systemic and ergonomic differences which may exist in immersive collaboration between co-localised users and remote ones.

Mixed Reality

During this period we continued our research in Augmented Virtuality for telepresence and telesupervision. The SACARI project (Supervision of an Autonomous Car with Augmented Reality Interface) aims to develop the concepts and techniques dedicated to the immersive teleoperation of a semi-autonomous vehicle. Up to 2012, the research was conducted with the Institut d'Electronique Fondamentale (IEF) who was in charge of developing the autonomous vehicle, while the VENISE group focused on the interactive aspects of remote supervision with an immersive setup. After this collaboration ended, the work shifted to psycho-ergonomic aspects of telepresence, i.e. evaluating the conditions of the creation of an effective immersive telepresence control. These aspects are gaining increasing interest in the context of drone control. We crafted a new, more complete definition of telepresence, by including cognitive considerations to the evaluation (evaluating the implication into the remote task), as well as system affordance measurements.

Recent work has consisted in a major overhaul of the complete hardware/software platform, as the technology is rapidly evolving. New hardware consisted in the addition of a panoramic camera (similar to the one used in the StreetView application) mounted on the SACARI robotic wheelchair, while the global system architecture was upgraded to the new BlenderVR sowtware platform (see above). This will insure a more efficient long-term maintenance of the system, as well as an increased portability to HMD systems (Oculus rift) which will be compared to existing CAVE-based interfaces.

Topic 2 « Data models and simulations »

N. Férey*, *J.-M. Vézien*, *P. Bourdot, *X. Martinez, P. Martin, A. Kouyoumdjian, M. Trellet, R. Cambuzat*

Interactive Molecular Simulation

The interactive molecular simulation approach consists for users to observe in real time the result of a simulation in progress and to manipulate the simulated object using classical or virtual reality interaction devices. On the one hand, this approach provides a quality control of new simulation models, and on the other hand, it allows one to interactively trigger and study some events that are not accessible in classical simulation, because of the rarity of these events and the limited simulation timescale. Moreover, in this approach the expertise of the researcher can be used during the simulation process that is necessary for the study of specific biophysical phenomena (including protein docking or folding), exclusively mobilized after the simulation process during the analysis stage of classical simulation results. This significantly shortens the simulation and analysis task loop, increases the relevance of the results, and thus decreases the amount of data to analyze after the simulation.

Following on his postdoctoral works and his previous collaborations in the Laboratory of Theoretical Biochemistry, *Nicolas Férey*, recruited as associate professor since the end of 2009, works on multi-scale and interactive molecular simulation model, taking profits of interaction modalities traditionally used in Virtual Reality. This approach was successfully used to study real research cases in structural biology, and was recently published in an international conference in Computer Science but also in the high impact factor journal *Faraday Discussion (Royal Society of Chemistry).*

New researches was also started at the end of 2012, focuses on issues coming from the huge increase of molecular simulation results in the ExaViz context ANR project. Indeed the classical working flow of molecular simulation analysis that consists to download simulation results provided by HPC ressources into the research labs, is no longer applicable. The main goals of this work is to propose new workflows and usage based on allowing to lead simulation and analysis in the same interactive context, especially in a virtual context. This work is led by *Mikael Trellet* who was hired in September 2012 as a PhD student on the 4 years ANR project ExaViz, and includes fondamental work about navigation dedicated to molecular content previously mentioned.

More recently, new fondamental issues of human computer concerning picking of moving targets emerges from the use of interactive molecular simulations. During a simulation in progress, atoms moves following a unpredictable way, and picking these moving targets before applying a force on it, is therefore a very hard task. *Alexandre Kouyoumdjian* started his Ph.D since 2012 on studying this complex task in order to provide new picking paradigm well adapted to deal with moving targets.

Finally, from September 2014, another project started led by the PhD student *Xavier Martinez* concerning the design and use deformable and modular tangible interfaces of molecular peptide, as an input device to control a simulation peptide. This targeted results of this work is a serious game available for teaching purposes, but also in research ones.

VR-CAD integration

The general goal of this research is to study the integration of Virtual Reality (VR) and Computer-Aided Design (CAD). Our approach aims to create a VR-CAD framework to enable intuitive and direct 3D edition on CAD objects within Virtual Environments (VE). Such a framework can be applied to collaborative part design activities and to immersive project reviews, in relation to Product Lifecycle Management (PLM). The cornerstone of our approach is a model we started to elaborate in 2003, which manages implicit editing of CAD objects. This model aimed to create a backward chaining

mechanism from B-Rep elements toward nodes of the *Construction History Graphs (CHG).* It was based on a labelling technique of B-Rep components and a set of logical rules to provide straight access to the operators of *CHG*. When using this model within a multimodal immersive interaction (combining for instance, 6 DoF tracking, speech and gesture recognition), we gain a direct and intuitive edition of the shapes of objects within a VE, thus avoiding explicit interactions with the CHG within a classical WIMP interface.

However, up to recently, the main showcase of our VR-CAD framework was implemented on OpenCASCADE. Our model being based on fundamental concepts of CAD systems (CHG, B-Rep, form feature, persistent naming), starting in 2011 we worked on the generalisation of this framework, in order to apply it to several popular commercial CAD systems. This was the objective of the CIFRE fellowship with Peugeot-Citroën which supported the PhD of *Pierre Martin*. This PhD was defended last July with a number of interesting results.

A first contribution is to propose a data model and architecture to generalize this backward chaining mechanism to most CAD systems, thanks to the design of several encapsulations structures, to manage CHG operators and their parameters, and the B-Rep components. Secondly, the previous labelling, now attached to these structures, has been extended to enable a multi-backward chaining. This was necessary, because the previous model was not taking into account that several CHG operators may be involved in the definition of some B-Rep elements, and thus, that several decisions may be inferred for their modification. These improvements make it possible to provide direct and interactive modifications of existing CAD objects by parsing their CHG to fill our structures with useful data. Moreover, the multi-backward chaining mechanism reinforces the ability of the inference engine to free users, especially non-expert ones, from too complex an understanding on CAD models. As a proof of concept, this model has been applied on the geometric kernel of CATIA and show how one can consider new concepts of interaction during immersive project reviews: to allow participants to directly modify CAD objects without any interaction on desktop workstation. Apart a publication activity with this former PhD on multimodal and collaborative immersive interaction (see topic 1), we are finishing a long paper on this VR-CAD model, to be submitted at the International Journal on Interactive Manufacturing and Design.

A Engineering school student has been recruited last summer (*Rémi Cambuzat*) to participate to the development of the demonstrator of our VR-CAD model, with future plans for a possible PhD position.

Conclusion

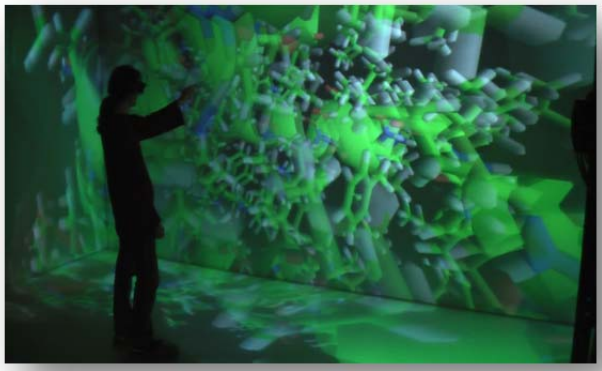
The national and international outreach of the VENISE group continues to be satisfactory. Founding member (as secretary) of the French Association for Virtual Reality (AFRV) and member of the Executive Board of its European counterpart (EuroVR), we organized again with success an international conference (cf. JVRC 2013), while we supported in September 2014 a new one in Italy, co-chairing with University of Salento the 1st International Conference on Augmented and Virtual Reality (http://www.salentoavr.it/).

Despite of the small size of the VENISE group, we reached a high quality upto an excellence in our scientific production, as evidenced by our works published at IEEE VR, the best international conference on VR, and in PRESENCE, the first journal in the field of Teleoperators and Virtual Environments.

In terms of interaction with the social, economic and cultural environment, the VENISE group actively contributes to the outreach of the laboratory and CNRS in general. Although small, the team is frequently solicited for demonstrations (2-3 per month) for a large variety of audiences: researchers in other academic areas, students from other disciplines (STAPS, Physics, Biology, Design, etc.). Thus

innovative ideas are spread to a wide audience due to the very tangible nature of our research, but we also contribute greatly to the popularization of our domain in printed material and on the web (Youtube movies, interviews, Digiteo or ANR symposiums). As noted earlier, our work interests industrial companies (EADS, PSA), and the EVE system serves as a prototype showcasing several of the technologies of our suppliers (BARCO, Haption, Volfoni ...).

Regarding the involvement in research training, we can see that relative to the number of HDR in the group, VENISE comes first in terms of ratio of phD supervision within the CHM department. We actively participate in the Computer Science Doctoral School, by managing a compulsory module and contributing to several elective courses in the “Interaction” Masters program of University Paris-Sud. Permanent members of the group also teach Masters classes in other universities or Engineering Schools in the Paris area. The team was also the initiator and linchpin in the creation of a practical training room dedicated to Virtual Reality. Another important element of implication is the dissemination of young researchers, both in academia and in the industrial world (several of our former doctors were recruited by EADS as R&D engineers in our field of research). However, if our training of doctoral students is greatly appreciated, this success paradoxically highlights our lack of tenured researchers: scientific contributions are transferred to the industrial environment without generating internal growth.



Our multi-user and multi-platform virtual collaborative environment designed for the Equipex DIGISCOPE project. At left, a user exploring his molecular results in our immersive environment EVE. At right, another user visualizing the same molecular content using the high definition powerwall WILD, sharing the content and the interaction context. The targeted application, PyMol, was tune to be set up on heterogeneous platforms, and was augmented with collaboration features.

Staff

Permanent staff

Last name	First name	Position	Employer	HDR	Arrived	Left
Bourdot	Patrick	DR2	CNRS	HDR		
Ferey	Nicolas	MC	Université Paris-Sud			
Touraine	Damien	IR2	CNRS			31/10/2014
Vézien	Jean-Marc	IR1	CNRS			

PhD Students

Last name	First name	Arrived	Thesis defense	Ecole Doctorale	School / University
Chen	Weiya	01/10/2012		EDIPS	Université Paris-Sud
Kouyoumdjian	Alexandre	01/10/2013		EDIPS	Université Paris-Sud
Martin	Pierre	01/05/2011	07/07/2014	EDIPS	Université Paris-Sud
Martinez	Xavier	01/10/2014		EDIPS	Université Paris-Sud
Trellet	Mikaël	01/10/2012		EDIPS	Université Paris-Sud
Chen	Weiya	01/10/2012		EDIPS	Université Paris-Sud
Kouyoumdjian	Alexandre	01/10/2013		EDIPS	Université Paris-Sud
Martin	Pierre	01/05/2011	07/07/2014	EDIPS	Université Paris-Sud
Martinez	Xavier	01/10/2014		EDIPS	Université Paris-Sud

Non permanent staff

Last name	First name	Position	Employer	Arrived	Left
Kooli	Amani	CDD IE	CNRS	01/10/2013	31/05/2015
Ladeveze	Nicolas	CDD Chercheur	CNRS	01/10/2013	31/12/2014
Ladeveze	Nicolas	CDD Chercheur	CNRS	01/01/2015	31/12/2015
Thorpe	Jonathan	CDD IE	CNRS	01/10/2013	31/05/2015
Tézier	Gabriel	CDD IE	CNRS	01/06/2012	01/09/2014
Hellequin	Rémi	CDD IE	CNRS	01/09/2014	

Internships

Last name	First name	Arrived	Left	Prepared degree	School / University
Audéoud	Yannick	20/02/2013	30/04/2013	Master Informatique	Université Paris-Sud
Cambuzat	Rémi	05/05/2014	26/09/2014	M1	EFREI
Capel	Benjamin	20/02/2013	30/04/2013	Master	Université Paris-Sud
Couble	Nelson	10/06/2013	02/09/2013	DUT informatique	Université Paris-Sud
Delmas	Jean	20/02/2013	30/04/2013	Master	Université Paris-Sud
Fontanet	Audrey	16/06/2014	05/09/2014	Ingénieur	Supélec
Gouriou	Stephen	23/06/2014	29/08/2014	DUT informatique	Université Paris-Sud
He	Xiaoqiu	28/03/2013	14/09/2013	M2 DFE	Université Paris-Sud
Li	Hang	01/05/2014	31/07/2014	DUT	Université Paris-Sud IUT Cachan
Mallik	Qasim	01/03/2013	30/09/2013	Master	Université Paris-Sud
Tseu	Anthony	15/04/2013	29/09/2013	Ingénieur	EFREI
Zhao	Jingru	02/05/2013	30/09/2013	Master Biométrie	Université Paris Est Créteil

Indicators of scientific notoriety

Editorial committees in journals

- P. Bourdot (Ed.) JVRC 2013 - 5th Joint Virtual Reality Conference of EGVE and EuroVR: Poster, Demo and Industrial track Proceedings. 11-13 December 2013, Campus Paris-Saclay, France. CNRS-LIMSI VENISE Edition, 2013. ISBN: 978-2-9547270-0-4

Organization of international or national scientific events

Member of the scientific, technical program and/or organizational committees for international/ national conferences or workshops

- Organizing committee of JVRC 2013, December 2013: P. Bourdot (General Conference Co-chair), N. Férey (Posters Committee Co-chair) J.-M. Vézien (JVRC-ICAT Collaborative Demo Committee Co-chair).
- Organizing committee of SALENTO AVR 2014, September 2014: P. Bourdot (Conference Co-chair).

Invited lectures, talks or seminars

Keynote speaker at international conferences

- P. Bourdot. Multimodal and Multi-user interactions in CAVEs: ongoing research on the EVE system. 19th ACM Symposium on Virtual Reality Software and Technology (VRST 2013). Nanyang Technological University (NTU), Singapore, October 2013.
- P. Bourdot, P. Gravez. Opening session of JVRC 2013, and overview of the V&AR research activities at CNRS/LIMSI and CEA/LIST. General chairmen of the 5th Joint Virtual Reality Conference of EGVE and EuroVR. Campus Paris Saclay, 11th December 2013.
- P. Bourdot, P. Gravez. Closing session of JVRC 2013: the highlights of the conference. General chairmen of the 5th Joint Virtual Reality Conference of EGVE and EuroVR. Campus Paris Saclay, 13th December 2013.
- P. Bourdot. Fully immersive modification of native CAD data during project reviews: recent results & remaining issues; 1st International Conference on Augmented and Virtual Reality (SALENTO AVR 2014). Lecce, Italy, September 2014.
- N. Férey et Céline Clavel, Apports de l'Ergonomie à la Réalité Virtuelle & Apports de la Réalité Virtuelle à l'Ergonomie,12e Journée d'Etude en Ergonomie (ADEO), Février 2013.
- N. Férey, Modèles d'Interaction et de Simulation en Réalité Virtuelle et Augmentée, Journée Centre Image, Reims, Mars 2014.

Participation in expertise and administration of research

International networks

- P. Bourdot: Founding member of EuroVR (European association of Virtual and Augmented Reality) and member of Executive Board in charge of scientific animation of Special Interest Groups (SIGs).

National networks or working groups

- J.-M. Vézien: member of the Information Signal Image and Vision (ISIS) GdR and LIMSI correspondent for ISIS.
- P. Bourdot: Founding secretary of AFRV (French association of Virtual and Augmented Reality).

Participation in evaluation or expertise committees

National committees (CoNRS, CNU, CCSU…)

- N. Férey: CCSU members of the Computer Sciences department at University Paris-Sud: Expert for scientific evaluation committees

Member of the administration or advisory board

- P. Bourdot: Partner leader & co-chair of the Scientific Board of the Equipex « DIGISCOPE » project.

- J.-M. Vézien: Co-chair of the Technical committee of the Equipex « DIGISCOPE » project.

Member of selection juries

- P. Bourdot : Reviewer for WorldHaptics 2013
- P. Bourdot: Expert for TecSan call of ANR; May 2013.
- P. Bourdot: Reviewer and Jury member of the PhD of Yanncik DENNEMONT. Université d'Evry, July 2013.
- P. Bourdot: Reviewer for SALENTO AVR 2014; during Summer 2014.
- P. Bourdot, N. Férey: Reviewers for IEEE VR 2015; during Autumn 2014.
- P. Bourdot: Reviewer for IEEE 3DUI 2015; during Autumn 2014.
- N. Férey : Reviewer for IHM 2013 et 2014

Teaching activities and duties in relation to research

- P. Bourdot (resp.), J.-M. Vézien, and Nicolas Férey: « Réalité Virtuelle et Augmentée » course of the Interaction Master of Université Paris-Sud, in 2013 and 2014.
- J-M. Vézien: « Augmented Reality » introductory course of third year of PolyTech Orléans Engineering school, in 2013 and 2014.
- J-M. Vézien: « Augmented Reality and Computer Graphics» course of the Biometrics Master of Université Paris-Est Créteil, in 2013 and 2014.
- J-M. Vézien: « Virtual and Augmented Reality » course (4th year) of École Supérieure de Génie Infomatique in 2013 and 2014.
- N. Férey, J-M. Vézien, P. Bourdot: Installation and operation of a new Virtual and Augmented Reality teaching room (3D visualization, 3D audio, haptics) at the Computer Science department of Université Paris-Sud, in association with C. Fleury from LRI.

Research conventions and contracts

Starting date	Ending date	Acronym	Category	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/09/11	29/02/16	ExaViz	Collaboration de recherche	ANR	Baaden Marc	Ferey Nicolas	National	120 536	Modèles Numériques
01/03/11	31/12/19	DIGISCOPE	Collaboration de recherche	Investissement d'avenir	Beaudoin-Lafon Michel	Bourdot Patrick	National	687 383	Equipex
09/01/12	08/01/27	DIGIPODS	Collaboration de recherche	Région Ile de France	Beaudouin-Lafon Michel	Bourdot Patrick	National	147 500	SESAME
01/08/12	30/07/16	BiLi	Collaboration de recherche	OSEO	Parmentier Matthieu	Katz Brian	National	392 000	Pôle de compétitivité
02/09/13	01/04/15	IDCOM	Collaboration de recherche	Digiteo	Bourdot Patrick	Bourdot Patrick	National	76 950	
01/08/13	31/07/14	JVRC 2013	Autre	Digiteo	Bourdot Patrick	Bourdot Patrick	National	4 000	Soutien Colloque
02/05/11	01/05/14		Collaboration de recherche	PCA	Bourdot Patrick	Bourdot Patrick	Industriel	53 626	CIFRE

Starting date	Ending date	Acronym	Category	Funding agency/ Partner	General coordinator	Responsible for LIMSI	Nature	LIMSI share €	Program
01/05/14	31/07/14		Collaboration de recherche	PCA	Bourdot Patrick	Bourdot Patrick	Industriel	18 522	
22/01/10	21/01/15	EuroVR & AFRV	Accord de secret	PCA	Bourdot Patrick	Bourdot Patrick	Industriel	-	Autre
22/01/10	21/01/15	SIMCoD	Accord de secret	PCA	Bourdot Patrick	Bourdot Patrick	Industriel	-	Autre

Industrial relationships

- P. Bourdot, Haption S.A. Showcase of Scale One in EVE system.
- P. Bourdot, BARCO S.A. Showcase of double stereoscopy and acoustic issues in EVE system.
- J.-M. Vézien, Intempora, Research collaboration on RTMaps
- P. Bourdot, Research convention with PSA Peugeot-Citroën (2011-2014)

Scientific publications

Doctoral theses and HdR

1. Martin, P., *Modèle pour la conception immersive et intuitive: application à l'industrie automobile* 2014, thèse de l'Université Paris Sud. Soutenue à Orsay, France, le 07/07/2014, 191 p.

Articles in peer reviewed scientific journals

1. Chen, W., C. Clavel, N. Ferey, and P. Bourdot, *Perceptual Conflicts in a Multi-Stereoscopic Immersive Virtual Environment: Case Study on Face-to-Face Interaction through an Avatar.* Presence: Teleoperators and Virtual Environments, 2014. **23** (4): pp.40.
2. Dreher, M., J. Prevoteau-Jonquet, M. Trellet, M. Piuzzi, M. Baaden, B. Raffin, N. Ferey, S. Robert, and S. Limet, *ExaViz: a flexible framework to analyse, steer and interact with molecular dynamics simulations.* Faraday Discussion, 2014. (169): pp.8.
3. Menelas, B., L. Picinali, P. Bourdot, and B. Katz, *Non-visual identification, localization, and selection of entities of interest in a 3D environment.* Journal on Multimodal User Interfaces, 2014. pp.1-14.
4. Molza, A.-E., N. Ferey, M. Czjzek, E. Le Rumeur, J.-F. Hubert, A. Tek, B. Laurent, M. Baaden, and O. Delalande, *Innovative interactive flexible docking method for multi-scale reconstruction elucidates dystrophin molecular assembly.* Faraday Discussion, 2014. (169): pp.18.

Books & chapters in books

1. De Hosson, C., I. Kermen, C. Maisch, E. Parizot, T. Doat, and J.-M. Vézien, *Learning Scenarios for 3D Virtual Environment : The Case of Special Relativity*. Springer ed 2014: Springer.
2. Deussen, O. and T. Isenberg, *Halftoning and stippling*, in *Image and video based artistic stylisation*, Rosin Paul and Collomosse John, Eds. 2013, Springer. pp. 45-61.
3. Isenberg, T., *Evaluating and validating non-photorealistic and illustrative rendering*, in *Image and video based artistic stylisation*, Rosin Paul and Collomosse John, Eds. 2013, Springer. pp. 311-331.

Conferences with proceedings and review committee

1. Chen, W., A. Plancoulaine, N. Ferey, D. Touraine, J. Nelson, and P. Bourdot. *6DoF navigation in virtual worlds: comparison of joystick-based and head-controlled paradigms*. in *ACM Symposium on Virtual Reality Software and Technology*. 2013. Nanyang, Singapore: ACM. 111-114.
2. Dreher, M., M. Piuzzi, A. Turki, M. Chavent, M. Baaden, N. Ferey, S. Limet, B. Raffin, and S. Robert. *Interactive Molecular Dynamics: Scaling up to Large Systems*. in *International Conference on Computational Science*. 2013. Barcelona, Spain: Elsevier. 1-11.

3. Karakos, Schwartz, Tsakalidis, l. zhang, s. ranjan, t. ng, R. Hsiao, G. saikumar, I. Bulyko, L. Nguyen, L. Lamel, and V.B. Le. *Score Normalization and System Combination for Improved Keyword Spotting*. in *IEEE Automatic Speech Recognition and Understanding Workshop*. 2013. Olomouc, Czech Republic. 6.
4. Mallik, Q., N. Ferey, and G. Bouyer. *Using Conceptual Graph to embed expert knowledge in VR interactions: Application to Strutural Biology*. in *Joint Virtual Reality Conference*. 2013. Campus Paris-Saclay, France.
5. Martin, P., A. Tseu, N. Ferey, D. Touraine, and P. Bourdot. *A hardware and software architecture to deal with multimodal and collaborative interactions in multiuser virtual reality environments*. in *SPIE Electronic Imaging*. 2014. San Francisco, USA. 16.
6. Poirier-Quinot, D., D. Touraine, and B. Katz. *BlenderCAVE: a flexible opensource authoring tool dedicated to multimodal virtual reality*. in *Joint Virtual Reality Conference of EuroVR - EGVE - VEC*. 2013. Orsay, France. 19-22.
7. Tek, A., M. Baaden, N. Ferey, and P. Bourdot. *MANHaptic: a haptic adaptive method for precise manipulation, assembly and navigation*. in *International Conference on Human Machine Interaction*. 2013. Chennai, India. 1-5.
8. Trellet, M., N. Ferey, M. Baaden, and P. Bourdot. *Visualisation Analytique Immersive de données de simulation moléculaire*. in *Journées Ouvertes en Biologie, Informatique et Mathématiques*. 2013. Toulouse, France.
9. Trellet, M., N. Ferey, M. Baaden, and P. Bourdot. *Content-guided navigation for molecular explotation*. in *Joint Virtual Reality Conference*. 2013. Paris Saclay, France.
10. Trellet, M., N. Ferey, M. Baaden, and P. Bourdot. *Navigation guidée par le contenu pour l'exploration moléculaire*. in *8è Journées de l'AFRV*. 2013: AFRV. 67-72.
11. Trellet, M., N. Ferey, M. Baaden, and P. Bourdot. *Content-guided navigation in multimeric molecular complexes*. in *International Conference on Bioimaging*. 2014. Angers, France: SciTePress. 76-81.

Conferences without proceedings, workshops

1. Trellet, M., N. Ferey, P. Bourdot, and M. Baaden. *Navigation guidée par le contenu pour l'exploration moléculaire*. in *4ème Journée Visualisation Scientifique et d'Information*. 2013: Institut de Biologie Physico-Chimique.

VIDA
Virtuality, Interaction, Design & Art

NATHALIE DELPRAT - CHRISTIAN JACQUEMIN

The VIDA (Virtuality, Interaction, Design, & Art) Action gathers researchers, PhD students, and engineers working in collaboration with creative professionals (artists, designers, architects...) and interested by interdisciplinary approaches, including interactions with Human Sciences.

As a transverse action, VIDA gathers members of various groups at LIMSI and covers 3 themes:

- Virtual and Augmented Reality for the performing arts, architecture and, visual arts,
- Multimodal human-computer interaction for social life, music, dance, or theater performance
- Virtual materiality for cognitive experiments in arts and sciences.

Most projects developed in VIDA have been published both as scientific works and as artistic events such as live performances, exhibitions, or art/science mediations in public space. In addition to dual publishing, an art/science collaboration is considered as successful if both the artist and the scientist end up with an original research topic that would not have emerged if they had not worked together. Some of these projects are reported here. More details and other activities (such as the Interferences_VIDA or the participation to the Diagonale Paris-Saclay) can be found on VIDA wiki http://vida.limsi.fr/.

VIDA has fostered the development of new themes at LIMSI and involved permanent researchers or PhD students for short or long term projects. The diversity and the quality of the publications confirm the potentialities of this research area. Its echo in the local, national, and international academic community shows that LIMSI is now recognized as a major actor in this area.

Research activities

Topic 1 : virtual and augmented reality in arts

C. d'Alessandro, F. Bimbard, P.-A. Bokaris, N. Delprat, M. Gouiffès, E.Frenoux, C. Jacquemin, B. FG Katz, J-C Martin

Digital media are now involved in the design of many artworks, either during the production phase, or as part of the work itself. Artistic uses of Virtual or Augmented Reality as part of the art piece focus on issues such as immediacy and intuitiveness (so that the onlooker can be quickly and spontaneously engaged in the work), presence (so that the viewer perceives her/himself as part of the work), and continuity (so that the real and the virtual world appear as perceptually and cognitively connected).

Illustration 1
Gardien du Temple, Véronique Caye
Laboratoire Victor Vérité

Illustration 2
Stupahonic Circus, Olivier Delarozière,
Woodstacker

Gardien du temple. Presence concealment and revelation for the live performance. Panagiotis-Alexandros Bokaris thesis work is a collaboration between LIMSI-CNRS, LadHyX, and the theater company Laboratoire Victor Vérité. Real-time color compensation and image analysis are studied for the purpose of modifying the appearance of possibly mobile objects on stage and camouflage them.

Stupaphonic experiment. As a part of the Woodstacker Stupaphonic project, a collaboration combining an artistic exploration in architectural construction based on stacked elements and the scientific study of the resulting unique acoustic of these constructions, the Stupaphonic Experiment examines the use of scale models to separate different construction features and their associated acoustics effects. In exploring the interest of the specific acoustic for musical performance with artist Olivier Delarozière, a computational platform was created to utilize the scale model as a physical convolution reverberation unit for musical performance.

Stupaphonic circus. The Stupaphonic Circus is a study for an installation, financed by the La Diagonale Paris-Saclay, 2014-2015, with artist Olivier Delarozière. The previous off-line audio processing will be adapted to real-time operation. Results of acoustical studies will contribute to the refinement of the design of a series of structures which will be presented as part of an interactive architectural-acoustic installation using mutli-scale constructions.

Topic 2 : multimodal human-computer interaction in arts

C. d'Alessandro, M. Ammi, N. Delprat, L. Feugère, B. FG Katz, J-C Martin, O. Perrotin, A. Rilliard

Chorus digitalis. *Chorus Digitalis* is a digital choir, using the chironomic digital singer Cantor Digitalis, which is an open-source real-time singing synthesizer controlled by hand gestures. It is developed by S. Le Beux, L. Feugère, B. Doval, O. Perrotin and C. d'Alessandro. A wide variety of voices are available, from the classic vocal quartet, to the extreme colors of childish, breathy, roaring voices. All the features of vocal sounds are entirely under control, as the synthesis method is based on a mathematic model of voice production, without prerecording segments.The instrument is controlled using chironomy, i.e. hand gestures, with the help of interfaces like stylus or fingers on a graphic tablet or computer mouse. Vocal dimensions such as the melody, vocal effort, vowel, voice tension, vocal tract size, breathiness can easily be controlled during performance, and special voices can be prepared in advance or using presets. A synthetic sound is all the more realistic than its parameters are not static. Hence the interface must allow a precise, repeatable, intuitive and constantly dynamic gesture. The pen tablet, initially designed for computer drawing, meets this criterion by using a gesture known by all and practiced since the childhood. Compared to mouse or trackpad, the tablet offers the possibility of playing subtle modulations of parameters, essential for the sound quality. The touch technology takes advantage of a new but spreader and spreader use of fingers on phones and computer tablets.

Wired harmony. Following the line of the ORA (Orgue et Réalité Augmentée) project, the Wired Harmony project is devoted to digital augmentation of the acoustic piano. This project reconsidered the Pure Data patch and effects initially developed for ORA (by M.Noisternig and C.d'Alessandro) in the context of the piano. Compared to the organ sounds, the piano sounds are percussive, spatially focused, relatively short, and highly dynamic. Sound is captured inside the piano and restituted outside using loudspeakers. The sound of the augmented piano is intimately blended with the sound of the acoustic piano resulting in an augmentation, a sound symbiosis, rather than a piano + electronic sound. This work has been presented during a concert of improvised music (piano, digital effect, percussion, R. Morier, C. d'Alessandro and L. Feugère) and two 2-hours workshops in the framework of the Curiositas 2014 festival in Orsay.

Illustration 3
Augmented piano, Curiositas 2014

Illustration 4
The Chorus Digitalis, Curiositas, 2013

La lumière ne s'arrête pas là. Developed at the neticLab on the Paris-Sud University campus La lumière ne s'arrête pas là represents to visitors the dependencies of the space-time metric with gravity by means of immersive video and sound projections. The installation is a mobile cybernetic prototype, which consists of a Lorentz room and a number of projectors set up inside and outside. Visitors can slide in one of the seven chambers attached to the room to explore the inside immersive and interactive projection. When visitors face shows up in the room and moves around, inferred perturbations are calculated to correspondinigly modify the space-time projection. The videoprojectors outside cover the Lorentz room environment and surrounding, thus inviting visitors to come closer and to slide in the room. M. Gouiffès and A. Setkov have participated to the project by developing the interaction module and tools for projection and sound control.

Les reflets sonores is an interactive, augmented and musical space. The visitor will augment the space, visually and acoustically by touching or caressing the objects in the scene. The development of this installation is based on image analysis, natural interaction, real-time compution. A collaboration will be made with a musician.

Topic 3 : virtual materiality for cognitive experiments in arts and sciences

N. Delprat, F. Focone, T. Giraud, M. Gouiffès, C. Jacquemin

The development of interactive simulations in immersive environments has brought physicality into virtual images, and has made users experience these environments through several sensorial modalities. Thus, many performance works in dance or theater have investigated intuitive interactions with virtual matters in new cognitive contexts. Similarly, the body virtualization through its augmentation or its digital representation raises various questions on virtual materiality embodiement and provides stimulating perspectives for art-science collaborations.

Illustration 5 – RêvA - ECHO(S), video, N.Delprat (photo credit N. Delprat)

Illustration 6 –Première Initimité de l'Etre Des Vues de l'Esprit, I.Maitre – Le Pixel Blanc

RÊVA offers further developments of the cloud-avatar problematics (N.Delprat, CLOUD project on the embodied experience of an evanescent matter) through the investigation of the so-called paradigm of Augmented Reverie. With reference to Augmented Reality, the purpose is to study the correlations between perceptual illusion and imaginative perception through the virtual augmentation of an imaginary experience. In addition to the implementation of experimental protocols for the analysis of the relationships between virtual materiality, bodily consciousness and imagination, ECHO(S) and ECHO(S)II (video and award-winning video installation at the October Digital Festival Arles, 2014) are a part of this art-science exploration on the subject and its digital doubles. On the right side of the video, a person is interacting with his/her cloud-avatar. On the left side two cloud-avatars, which are generated by the same interactive simulation system, are interacting in their own way. The two parts of the screen are not virtually airtight or watertight. There exist multiple sound and visual correspondences between them as well as combined resonances that reflect the physical properties of a cloud. In the video installation, two monitors are facing each other showing one part of the screen only. This configuration allows the viewer to be immerged in different imaginary spaces and to experience in real-time the ambivalence of mixed realities.

Autoportrait is a large project exploring the relationships between our inner body revealed by modern imaging technologies, our intimate self-image and our interactions with others. Several teams with various backgrounds are involved in Autoportrait: the digital art company DesVuesDeLesprit, the medical imaging laboratory IR4M and VIDA members from LIMSI-CNRS. Several productions emerged from these synergies, such as *Primary Intimacy of Beings, Turbulent, Tout un Monde and Tout Passe.*

Highlights

Interferences VIDA is a series of seminars with two speakers (artists and/or scientists) working on complementary topics from distinct perspectives. Because of these different point of views, the purpose is to foster cross-disciplinary discussions and exchanges between the speakers and the audience through various art-science approaches.

Award winning projects

In art-science festivals

- Wired Harmony, Curiositas, 2014
- ECHO(S) and ECHO(S)II, Digital October, 2014

Art-science foundings

- Stupaphonic Circus, Diagonale Paris-Saclay, 2014-2015
- Gardien du Temple, Diagonale Paris-Saclay, 2014-2015

Indicators of scientific notoriety

Editorial board

- TSI, Special issue on art and Computer Science, June 2013, Christian Jacquemin and Alain Lioret editors.

Member of programme committee in international conferences and workshops

- C. Jacquemin : ACM Multimedia 2013 (art track) – CHI Interaction 2014, 2013 – Computer Art Congress 2014– Digital Arts and HCI Work-in-progress @ CHI 2014 – H2PTM 2013– International Workshop on Movement and Computing 2014 – INTETAIN 2014 – Human Behavior Understanding @ ACM Multimedia 2013 – Mirage 2013 – SmartGraphics 2014 – VRIC 2014, 2013

Invited lectures, talks or seminars

- N. Delprat, Art-science interactions, seminar at CETHIL, INSA-CNRS, Lyon 1 University, january 17, 2013
- N.Delprat, Virtual materiality and material imagination: cognitive impact of the cloud-avatar experience, seminar given at Emotion Center-CNRS, Pitié-Salpétrière, Paris, march 8, 2013
- N. Delprat, The Augmented Reverie paradigm: between perceptive illusion and imaginative adhesion, seminar given at the Center of Contemporary Ethics, Epsylon Laboratory, Paul Valéry University, october 15, 2013
- N. Delprat, The Art-science Dialog, invited talk at the Digital October Conferences, Arles, october 16, 2014
- N. Delprat, Art and Science, invited talk at Conférences Horizon, Pierre and Marie Curie University, november 25, 2014
- C. Jacquemin, Diagonale de Saclay: Promesses versus difficultés ? Talk given at Séminaires « Arts et Sciences » organised by ISCC and A.R.T.S. Maison des Sciences de l'Homme de Clermont-Ferrand, USR 3550, february 20, 2014
- C. Jacquemin, Le numérique en arts et sciences : de la diversité de cette alliance par l'exemple, Talk given at 7e cycle annuel des journées d'étude PraTiC: La démarche Arts-Sciences face au numérique, Gobelins, l'école de l'image, 16 january 2014
- C. Jacquemin, CURIOSITas 2013: A New Art-science Academic Festival, Talk given at International Conference OPEN SCIENCE. Science communication in modern society, Polytechnic Museum, Moscow, 11-12 December, 2013
- C. Jacquemin, CURIOSITas 2013 : Genese et perspectives d'un nouveau festival universitaire Arts & Sciences, Talk given at Conférence H2PTM '2013 : Hypertexte et Hypermédia, CNAM, Paris, 16, 17 and 18 october, 2013
- C. d'Alessandro « I : Glossolalies électroniques: autour de la synthèse vocale ; II Gloses et glossolalies : la parole come modèle », CUTE 2014, Masterclass Series on Culture and Technology, March 12-15, 2014UMONS Institute for Creative Technologies (numediart), Mons, Belgium, 2014

Participation in expertise and administration of research

International networks

- Contribution to the SEAD (International Network for Science, Engineering, Arts and Design), 2013
- Participation to the Diagonale Paris-Saclay project (as representatives in both the Steering Committee and the Scientific Committee)

Teaching activities and duties in relation to research

- Virtual Humans (TER in Master 1st year, and option in Master 2d year at Université Paris-Sud), Computer Graphics course at Polytech and GPU programming for Image Processing (option in Master 2d year at Université Paris-Sud)
- The musical sound (in L2, UPMC)
- Sciences and Music (in L1, Atelier de Recherche Encadrée and U.E méthodologie, UPMC)

Dissemination and vulgarization

Art-science mediation

1. Festival CuriositAS, U-PSUD, September 2013
2. Support for the creation of ICREas (Initiative CRéation Etudiante Arts-Sciences),Université Paris-Sud 2014
3. Art-science doctoral mission, Alexander Stekov 2013
4. Interferences_VIDA, 5 seminars in 2013-2014: Z. Pavé (artist), P. Pasquier (computer scientist, Simon Fraser University) & Thierry Coduys (artist, stage director), E.Ferrand (mathematician, Pierre and Marie Curie University) & G. Hutzler, (computer scientist, University of Evry), J-M Chomaz (physicist, LadHyX and École Polytechique) & Serge Reynaud (artist), M. Almiron (artist and computer scientist, Paris-Est University) & B. Trentini (philosopher, Paris 1 University)

Art-science exhibitions or performances

1. Primary Intimacy of Beings at Le Pass, Mons, Belgium, 2013-2018
2. Primary Intimacy of Beings at South By West festival, Austin, Texas, USA, 2014
3. Turbulent at the inauguration of the Google Cultural Institute, Paris, France, November-July 2013
4. Tout un monde at Futur en Seine, Paris, France, June 2014
5. Tout Passe at Curiositas, Festival, Orsay, France, october 2014
6. ECHO(S) video (5'17"), The Digital October Festival, Espace Van Gogh Arles, october 2014
7. ECHO(S)II video installation, The Digital October Festival, Espace Van Gogh Arles, october 2014
8. Wired Harmony, workshop and concert, Festival Curiositas, october 2014 (C. d'Alessandro, R.Morier, L. Feugère)
9. Cantor Digitalis, concert Proto 204, June 2014 (L. Feugère, O. Perrotin, B. Doval, S. Delalez, C. d'Alessandro, A. Braffort, S. Jacquin : Cantor Digitalis, spinet, tablas and guitar)
10. Organ and Augmented Reality installation, two public concerts at Ste Elisabeth church (January 2014 and June 2014, E. Lebrun, and M. Pinardel : augmented organ) and several private demonstrations for organists and composers.

Scientific publications

Articles in peer reviewed scientific journals

1. Delprat N. and C. Jacquemin, VIDA - Une thématique art-science dans un laboratoire de recherche scientifique. Technique et Science Informatiques, 2013, 32 (3-4): pp.499-502.

2. Delprat N., Walking clouds and Augmented Reverie, Leonardo MIT Press Journal, Vol. 47, n°1, February 2014
3. S. Fdili Alaoui, C. Henry, and C. Jacquemin. Physical modelling for interactive installations and the performing arts, International Journal of Performance Arts, and Digital Media (IJPADM), vol. 10, no 2, 159-178, 2014
4. S. Fdili Alaoui, F. Bevilacqua, B. Bermudez Pascual, and C. Jacquemin, Dance Interaction with physical model visuals based on movement qualities, International Journal of Arts and Technology, IJART, vol. 6, no 4, 357-38, 2013
5. M. Gouiffes, B. Planes, C. Jacquemin, HTRI: High Time Range Imaging, Journal of Visual Communication and Image Representation, vol. 24, no 3, 361-372, 2013
6. C.Jacquemin, A. Lioret, Introduction to a special Art et Informatique, Techniques et Sciences Informatiques, Vol 32/3-4, pp.309-311, Hermes éditeur, Paris, 2013.
7. C.d'Alessandro, L. Feugère, S. Le Beux, O. Perrotin, and A. Rilliard, « Drawing melodies : evaluation of chironomic singing synthesis » , J. Acoust. Soc. Am. 135 (6), 3601-3612, 2014

Books & chapters in books

- Delprat N., Walking clouds and Augmented Reverie in Water is in the Air: Physics, Politics and Poetics of Water in the Arts, Annick Bureaud (Ed.), Leonardo/ISAST, MIT Press, Leonardo ebook series, Kindle Edition, February 2014

Conferences with proceedings and review committee

1. O. Perrotin, C. d'Alessandro, "Visualizing Gestures in the Control of a Digital Musical Instrument", Proceedings of the 2014 International Conference on New Interfaces for Musical Expression (NIME14), Goldsmiths, University of London, UK, June 30-July 4, 2014, pp. 605-608
2. L. Feugère, C. d'Alessandro, « Gesture analysis of voice synthesis chironomy », 14th International Conference on New Interfaces for Musical Expression (NIME 2014), London, UK, pp 86-87
3. Lionel Feugère, Christophe d'Alessandro, and Boris Doval, (2013) « Performative voice synthesis for edutainment in acoustic phonetics and singing: a case study using the Cantor Digitalis », Proc. 5th International Conference on Intelligent Technologies for Interactive Entertainment, Revised and selected papers, LNICST 124, pp. 169–178, 2013
4. O. Perrotin, C. d'Alessandro, "Adaptive mapping for improved pitch accuracy on touch user interfaces", Proceedings of the 2013 International Conference on New Interfaces for Musical Expression (NIME13), Daejeon + Seoul, Korea Republic, May 27-30, 2013, pp. 186-189
5. Delprat N., Virtual temporalities and body realities, International Symposium on the Digital Subject, University of Paris 8 Vincennes Saint-Denis, Archives nationales, November 12-14, 2014.
6. L. Feugère, C. d'Alessandro, « Digitartic: bi-manual gestural control of articulation in performative singing synthesis, » 13th International Conference on New Interfaces for Musical Expression (NIME 2013), Daejon, Korea, 27/05 au 30/05, 2013, 331-336.
7. L. Feugère, C. d'Alessandro, and B. Doval, «Performative Voice Synthesis for Edutainment in Acoustic Phonetics and Singing: A Case Study Using the "Cantor Digitalis », M. Mancas et al. (Eds.): », 5th International Conference on Intelligent Technologies for Interactive Entertainment, INTETAIN 2013, Revised and Selected papers, LNICST 124, pp. 169–178, 2013
8. Giraud T., Courgeon M., Tardieux M., Roatis A., Maitre X. A three-dimensional mirror augmented by medical imaging: Questioning self-portraying at the limit of intimacy, CHI '14 Extended Abstracts on Human Factors in Computing Systems (CHI EA '14), Toronto, 04/2014

9. B. F. Katz, M. Noisternig, and O. Delarozière, Scale model auralization for art science and music: The Stupaphonic experiment, in EAA Joint Symposium on Auralization and Ambisonics, (Berlin), pp. 14–19, 3-5 April 2014
10. S. Fdili Alaoui, C. Jacquemin, F. Bevilacqua, Chiseling Bodies: an Augmented Dance Performance, CHI '13 Extended Abstracts on Human Factors in Computing Systems (CHI EA '13) (CHI EA '13 2013), Paris, 27/05 au 02/06, 2013, 2915-2918, paru dans ACM, New York, 2013

On-line publications

- C. Jacquemin, A. Conjard, N. Delprat, E. Mahé, R. Malina, H. Vinet, Emergence Of New Institutions For Art-Science Collaboration In France And Comparison Of Their Features With Those Of A Longer Established One, White Paper, SEAD (Science, Engineering, Art and Design) Network Initiative (under National Science Foundation Grant No.1142510), 2013

Open source software

- Cantor Digitalis as been released as an open source project under the CECILL licence in september 2014.

Glossary

Graduate Schools

- EDIPS: ED427, Ecole Doctorale en Informatique de Paris-Sud (Computer Science School, U-PSud)
- Matière Condensée et Interfaces: ED 518 Univ. Paris-Diderot (ex ED Phys. Macroscopique)
- MIPEGE: ED534, Modelisation et Instrumentation en Physique, Energies, Geosciences et Environnement (U-PSud)
- MSTIC: ED532 Mathématiques et STIC (Univ. Paris-Est and Marne-la-Vallée - UPEMLV)
- EDX: ED447, École Doctorale of École Polytechnique and ENSTA
- SISEO: ED489, Sciences et Ingénierie des Systèmes, de l'Environnement et des Organisations (Univ. Chambéry)
- SMAER: ED391, Sciences Mécanique, Acoustique, Electronique et Robotique (UPMC)
- SSMMH, ED456, Sciences du Sport, Motricité et du Mouvement Humain (U-PSud)
- STITS: ED422, Sciences et Technologies de l'Information, des Télécommunications et des Systèmes, (U-PSud, Supelec)

Universities, engineering schools, research organisms, funding agencies

- ADEME: Agence de l'Environnement et de la Maîtrise de l'Energie
- Alliance: National Thematic Federations of research organisms and universities
- ALLISTENE: the Alliance for Computer Science and IST
- ANCRE: The Alliance for energy
- ANDRA: Agence Nationale pour la gestion des déchets radioactifs
- ANR: Agence Nationale de la Recherche - National Research Agency
- ANR supports several research programs either of general type such as « basic science » or JCJC specific for young researchers, and more oriented ones like CONTINT, TecSan, MDCO, CSOSG…
- BRGM: Bureau de Recherches Géologiques et Minières
- CEA: Commissariat à l'Energie Atomique et aux Energies Alternatives
- CNAM: Conservatoire National des Arts et Métiers
- CNRS: Centre National de la Recherche Scientifique, National Center for Scientific Research
- CNES: Centre National d'Etudes Spatiales, National center for Space Studies

Competitiveness Cluster (Pôle de compétitivité)

Launched in 2005, these clusters aim at bringing together academis research and industrial needs on a regional basis. There are about 70 such clusters. The projects are funded by the Fonds Universel d'Investissement (FUI). LIMSI is tightly linked with two such clusters:

- Systematic: Competitiveness Cluster for IST located on the Plateau de Saclay
- CapDigital: Competitiveness Cluster for IST located downtown Paris
- CSIS : College of Engineering Sciences, convention between ECP, Supelec, ENS-Cachan and U-Psud
- DGA: Délégation Générale pour l'Armement
- DIGITEO: The RTRA dedicated to IST on Plateau de Saclay
- ECM: École Centrale de Marseille
- ECN: École Centrale de Nantes
- ECP: École Centrale de Paris
- ENPC: École National des Ponts et Chaussées
- ENS: École Normale Supérieure
- ENSAM: École Nationale Supérieure des Arts et Métiers

- ENSCI les Ateliers: Ecole Nationale Supérieure de Création Industrielle
- ENSIIE: École Nationale Supérieure d'Informatique pour l'Industrie et l'Entreprise
- ENSMA: École Nationale Supérieure de Mécanique et d'Aérotechnique, Poitiers
- ENSTA: École Nationale des Techniques Avancées (Engineering School for Advanced Technologies
- EdF: French Energy Commission
- EU: European Commission
- FCS: Foundation for Scientific Cooperation, managed under private regulation
- The FCS on the plateau de Saclay (FCSPS) runs the RTRA DIGITEO
- FP7: 7th Framework programme of the EU
- FUI: Fonds Universel d'Investissement: funds the projects of the competitiveness clusters
- GdR: Groupement de Recherche (National thematic federation of labs or research teams labelled by CNRS)
- IFSTTAR, Inst. Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux
- INP: Inst. National Polytechnique, local regroupment of engineering schools such as in Grenoble (INPG), Toulouse (INPT), Lorraine (INPL)
- INRA: National Institute for Agronomy Research
- INRIA: National Institute for Computer Science
- IRD: Inst. de Recherche pour le Développement
- IRSN: Inst. de Radioprotection et de Sûreté Nucléaire
- KIT: Karlsruher Institut für Technologie
- KTH: Kungliga Tekniska Högskolan, Royal Institute of Technology, Stockholm
- ONERA: Office National d'Etudes et de Recherches Aérospatiales
- OSEO: Funding agency for the small and medium private companies
- Polytech: Engineering school of Universities U-PSud and UPMC
- PRES: Pôle de Recherche de l'Enseignement Supérieur (Local Federation of Universities or Schools)
- PRES UniverSud gets together Supelec, U-Psud, ENS Cachan and ECP
- RTRA: Réseau Thématique de Recherche Avancée
- RTWH: Rheinisch-Westfaelische Technische Hochschule, Aachen
- Supelec: École Supérieure d'Electricité, Gif-sur-Yvette
- UCBN: University of Caen Basse Normandie
- UEVE: University of Evry-Val d'Essonne
- UJF: University Joseph Fourier (Grenoble)
- UPDD: University Paris Denis Diderot (Paris Diderot)
- UPEMLV: University Paris-Est Marne la Vallée
- UPMC: University Pierre & Marie Curie
- UPS: University Paul Sabatier Toulouse
- UPSay : University Paris-Saclay (IdEx)
- U-Psud: University Paris-Sud
- UPVD: University of Perpignan Via Dominici
- UVSQ: University of Versailles Saint-Quentin
- X: Ecole Polytechnique

The "Investments for the Future" initiative

In 2009, the government launched the "Investments for the future initiative" (35 billion €, 19 for research and higher education). This initiative aims at boosting the competitiveness of the french economy through an improved synergy between academic research and industrial needs in approximately 15 regional clusters of international visibility. Several modalities have been proposed on the basis of call for proposals which have been evaluated by international committees.

- EquipEX : Excellence equipment. Endowing research groups with major scientific equipments
- LabEx : Excellence laboratories ; getting together teams of high quality around major scientific challenges.
- IdEx : Institute of Excellence : local regroupment of universities, engineering schools, research organisms which want to join their forcesr to improve their international visibility.
- IEED : Institute of Excellence for Decarbonated Energies
- IRT : Institute for Technological Research

National or Local governing or evaluation bodies

- CCSU: Commission Consultative de Spécialistes de l'Université
- CoNRS: National Council of Scientific Research
- AERES: National Evaluation Agency for Research and Higher Education
- CNU: National Council of Universities

Positions

- DR: CNRS Directeur de Recherche: Senior Researcher
- CR: CNRS Chargé de Recherche: Junior Researcher
- Prof: University Professor
- Ass. Prof: University Assistant Professor
- HDR: Holder of ability to supervise PhD's
- ITA: CNRS employee: Engineer, Technician, or Administrative Staff
- CDD: Temporary position with specified ending date
- There are 4 types of CDD: PhD CDD, Post-Doc CDD, Research CDD, support CDD
- CDI: Permanent position
- CIFRE: PhD position (in general CDD) in a private company in relation with a laboratory

Laboratories with which LIMSI collaborates

- ALPAGE: Analyse Linguistique Profonde A Grande Echelle, UMR INRIA-Univ. Paris Diderot
- APC: AstroParticule et Cosmologie; UMR 7164 CNRS-CEA-Observatoire de Paris-Collège de France-Univ. Paris Diderot
- CEA/DAM: Division of Military Applications of CEA
- CEA/DSM/IRFU: Institut de Recherche sur les lois Fondamentales de l'Univers
- CEA/DRT/LIST: Laboratoire d'Intégration des Systèmes et des Technologies
- CERFACS: Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique, Toulouse
- CERMICS: Centre d'Enseignement et de Recherche en Mathématiques et Calcul Scientifique, ENPC-INRIA-UPEMLV
- CETHIL: Centre de Thermique de Lyon; UMR 5008 CNRS-INSA Lyon-Univ. Claude Bernard
- CReA: Centre de Recherche de l'Armée de l'Air
- DynFluid: Laboratoire de Dynamique des Fluides, EA92 Arts&Métiers ParisTech-CNAM
- EM2C: Energétique moléculaire et macroscopique, Combustion ; UPR CNRS 288, ECP
- ER-TIM: Equipe de Recherche « Textes, Informatique et Multilinguisme », EA 2520, INALCO
- E3S: Equipe Supélec Sciences des Systèmes
- ETIS: Equipes Traitement de l'Information et Système, UMR8051 CNRS-ENSEA-Univ. Cergy-Pontoise
- FAST: Fluides, Automatique, Systèmes Thermiques; UMR 7608 CNRS-UPMC-U-PSud
- G2ELab: Grenoble Génie Electrique, UMR 5269 CNRS UJF
- GEM: Institut de Recherche en Génie Civil et Mécanique, UMR6183 CNRS-ECN-Univ. Nantes
- Gipsa-Lab: Grenoble Images Parole Signal Automatique, UMR 5216 CNRS-Univ. de Grenoble

- GREYC: Groupe de Recherche en Informatique, Image, Automatique et Instrumentation de Caen, UMR 6072, CNRS-UCBN-ENSICAEN
- IBISC: Laboratoire d'Informatique, Biologie Intégrative et Systèmes Complexes; EA 4526, UEVE ENSIIE
- ICJ: Institut Camille Jordan, UMR5208 CNRS-Univ. Claude Bernard
- IEF: Institut Electronique Fondamentale, UMR 8622 CNRS - U-Psud
- IJLRA: Institut Jean Le Rond d'Alembert; UMR 7190 CNRS - UPMC
- ILSP: Institute for Language and Speech Processing, Athena Research Center (Greece)
- IMFT: Institut Mécanique des Fluides de Toulouse; UMR 5502 CNRS-INPT-UPS
- IPNO: Institut Physique Nucléaire d'Orsay, UMR CNRS – U-PSud
- IRCAM: Institut de Recherche et Coordination Acoustique/Musique
- IRISA: Institut Recherche en Informatique et Systèmes Aléatoires, UMR 6074 CNRS-Univ. Rennes-INSA-INRIA
- IRIT: Institut de Recherche en Informatique de Toulouse, UMR 5505 CNRS-UPS-INPT
- IRPHE: Institut de Recherche sur les Phénomènes Hors Equilibre, UMR 7342 CNRS-Univ. Aix-Marseille, ECMarseille
- ISTerre: Institut des Sciences de la Terre UMR 5275 CNRS-UJF-UdS-IRD-IFSTTAR
- LadHyX: Laboratoire d'Hydrodynamique de l'Ecole Polytechnique, UMR 7646 CNRS-X
- LAUM: Laboratoire d'Acoustique de l'Université du Maine, UMR6613 CNRS-Univ. du Maine
- LBT: Laboratoire de Biochimie Théorique, UPR CNRS 9080
- LEMTA: Laboratoire d'Energétique et de Mécanique Théorique et Appliquée; UMR 7563 CNRS-Univ. Lorraine
- LGEP: Laboratoire de Génie Electrique de Paris ; UMR 8507 CNRS-Supelec-U-PSud-UPMC
- LIF: Laboratoire d'Informatique Fondamentale de Marseille UMR 7279 CNRS-Univ. de la Méditerranée-Univ. de Provence

- LIFO: Laboratoire d'Informatique Fondamentale d'Orléans, EA 4022 Univ.Orléans-ENSI de Bourges
- LIG: Laboratoire d'Informatique de Grenoble ; UMR 5217 CNRS-UJF-INPG
- LIM: Laboratoire d'Informatique Médicale, Univ. Rennes
- LINA: Laboratoire d'Informatique de Nantes Atlantique, UMR 6241 CNRS-Univ. Nantes
- LIP6: Laboratoire d'Informatique de l'UPMC, UMR 7606 CNRS-UPMC
- LIPN: Laboratoire d'Informatique de Paris- Nord, UMR 7030 CNRS-Univ. Paris Nord
- LISV: Laboratyoire d'Ingénierie des Systèmes de Verssaille; EA 4048, UVSQ
- LIUM: Laboratoire d'Informatique de l'Université du Maine, EA 4023
- LIX: Laboratoire d'Informatique de l'X; UMR 7161, CNRS Ecole Polytechnique
- LJAD: Laboratoire Jean-Antoine Dieudonné, UMR 7351 CNRS-Univ. Nice Sophia-Antipolis
- LML: Laboratoire de Mécanique de Lille, UMR 8107, CNRS-Univ. Lille-ECL
- LMO: Laboratoire de Mathématiques d'Orsay UMR 8628 CNRS-U-PSud
- LORIA: Laboratoire Lorrain de Recherche en Informatique et ses Applications, UMR 7503 CNRS-Univ. de Lorraine-INRIA
- LPED: Laboratoire Population Environnement Développement, UMR 151 IRD-Univ Aix-Marseille
- LPGP: Laboratoire de Physique des Gaz et des Plasmas, UMR 8578, CNRS-U-PSud, Supelec
- LPL: Laboratoire Parole et Langage, UMR 7309 CNRS-Univ. de Provence
- LPNCog: Laboratoire de Psychologie et Neuropsychologie Cognitives, FRE 3292 CNRS-Univ. Paris Descartes
- LPP: Laboratoire de Phonétique et de Phonologie, UMR 7018, CNRS-Univ. Sorbonne Nouvelle
- LRI: Laboratoire de Recherche en Informatique; UMR 8623 CNRS-U-PSud
- LSPM: Laboratoire des Sciences des Procédés et des Matériaux; UPR CNRS 3407, Univ. Paris Nord
- LSV : Laboratoire Spécification et Vérification; UMR8643, ENS de Cachan
- LTCI: Laboratoire Traitement et Communication de l'Information, UMR 5141 CNRS-Telecom ParisTech

- LUTH: Laboratoire Univers et Théories, Observatoire de Paris, UMR8102 CNRS-Univ. Paris Diderot
- L2S: Laboratoire des Signaux et Systèmes, UMR 8506, CNRS-SupElec-U-PSud
- MAP: Modèles et simulations pour l'Architecture et le Patrimoine UMR 3495 CNRS-MCC
- MIG: Mathématique, Informatique et Génome, Unité INRA
- M2P2: Laboratoire de Mécanique, Modélisation et Procédés Propres, UMR6181 CNRS-Univ. Aix Marseille
- MODYCO: Modèles, Dynamiques, Corpus, UMR 7114 CNRS-Univ. Paris Ouest
- MSME: Laboratoire de Modélisation et Simulation Multi-Echelles, UMR 8208 CNRS-Univ. Marne la Vallée
- PIMENT : Laboratoire de Physique et d'Ingéniérie Mathématique pour l'Energie et l'Environnement, Univ. La Réunion
- PMMH: Physique et Mécanique des Milieux Hétérogènes, UMR 7636, CNRS-ESPCI-UPMC-UPDD
- PPRIME: Pôle Poitevin de Recherche et Ingénierie en Mécanique et Energétique; UPR CNRS 3346, ENSMA, Univ de Poitiers
- PRISM: Laboratoire d'Informatique PRISM; UMR 8144 CNRS-UVSQ
- PROMES: Laboratoire Procédés, Matériaux et Energie Solaire: UPR CNRS 8521, UPVD
- SAMOVAR: Services répartis, Architectures, MOdélisation, Validation, Administration des Réseaux; UMR5157 CNRS-TELECOM SudParis
- SATIE: Systèmes et Applications des Technologies de l'Information et de l'Energie ; UMR 8029 CNRS-ENS Cachan-CNAM Paris-Univ. Cergy-Pontoise